# THE SAE JOURNAL

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JANUARY THROUGH DECEMBER 1966-VOL. 74

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# Index of 1966 SAE Journal Articles

The Index of 1966 SAE Journal articles printed on these green pages is designed to make each moment you spend looking for information as productive as possible. The final objective is that you go back and read only articles that actually bear on your problem.

Here is the way to use the Index:

- · Look up the subject heading of interest.
- Select all the titles under each subject heading that are of specific interest. Note the 6-digit number to the right of each title.
- In the Abstract Section, which follows the Index, look up the selected Abstracts by means of the 6-digit numbers. (Abstracts are in numerical order.)
- Look up all the articles that the comprehensive Abstracts show should have information of use to you. (Each article can be located by means of the code number to the left of the 6-digit number in the Index. For example, JL66-8-70 means: SAE Journal, 1966, August, article starts on p. 70.)

This Index thus gives you two stages of prescreening before you start pulling old issues. In a way it is like making changes in the design stage of a product, rather than during production.

At each step of the way the Index is tailored to help you find information rapidly and efficiently. First, the subject headings used are those agreed upon by 14 technical societies in an Engineers Joint Council project to simplify interdisciplinary terminology and indexing. As part of this approach, each article is indexed, on the average, under three to five headings.

In addition, you will note that your chances of finding the articles you need in the 1966 Journal Index are greatly increased because of the inclusion of cross-index headings. Most of these are more general terms, which are designed to lead you to more specific terms, which might cover articles of direct interest to you. Two types of cross-index headings are used:

 "See" is used to relate broad concepts – under which there are no entries – to more specific terms under which entries will be found. For example:

### Design

see:

Aircraft Design
Bus Design
Construction Equipment Design
Engine Design
Passenger Car Design
Truck Design

"See also" is used to relate broad concepts –
under which are listed only very general papers
on the subject – to the specific terms under which
entries will be found. For example:

# Reliability

see also:

Aircraft Reliability Missile Reliability Spacecraft Reliability

An expanded title is used for each article under the subject headings. This helps in your first stage of prescreening, since the expanded title is really a very short Abstract. If you are looking only for background information in a new field, chances are you won't have to go beyond this point to find the articles you want.

Note that the inclusion of an Abstract for each technical article printed in SAE Journal during 1966 is a depth service that allows careful selection without your ever having to leave the green pages.

An Author Index is also included in these green pages so that you can find what articles have been contributed by a particular author.

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Device spots thermal breakdown of fuels at high Mach numbers JL66-2-82 660269

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Recent tests point to an autoignition explosion of the end-gas as the cause of engine knock JL66-4-72 660510

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Exploding auto industry of Japan is now fourth largest in world
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Adapting vehicle and highway to suit visual limitations of man can bring big safety dividends IL66-8-44 660807

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Powder Metallurgy / Powder Metals/
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Pitchline velocity is yardstick to transmissions pto ability
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Trend is toward larger, more efficient tractors, featuring driver comfort, four-wheel drive, and four-wheel steering JL66-4-66 660509

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Automatic Transmissions
Axles
Belts
Chain Drives
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Transmissions

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Power Transfer system improves fuel economy and braking in gas turbine applications
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Formula rates turbine powered race cars JL66-3-69 660488

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Radioisotope power for spacecraft applications continues to grow JL66-5-48 660523

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A proposed high-speed tube transportation system applies existing techniques to achieve a breakthrough in ground transportation JL66-6-36 660551

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High compressive stresses introduced during selective heat treatment improves fatigue characteristics of carbon and alloy steels
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Two types of undersea secondary propulsion units use seawater for bearing lubrication and motor cooling

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Spacecraft Simulators

SST traffic control problems are being investigated by joint NASA-FAA simulator program
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Light weight of gasoline engine achieved by design rather than by using exotic materials
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SNAP 10A is the first nuclear reactor to operate in space JL66-3-92 660496

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Small, light weight anow shovel uses a modified chain saw engine. It is anticlogging and will even clean steps

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Sonic booms of SST may prove unacceptable to 25 per cent of people affected JL66-6-88 660569

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Space walk of Astronaut White will aid future spacemen JL66-1-79 660247

Closed circuit TV plus models and mosaics simulate view from spacecraft window to evaluate visual operating capabilities of man JL66-3-78 660491

Both American and Russian astronauts report unpleasant sensations. Reactions to weightlessness needs further probing JL66-5-83 660532

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### Spacecraft Simulators

Closed circuit TV plus models and mosaics simulate view from spacecraft window to evaluate visual operating capabilities of man IL66-3-78 660491

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Spontaneous ignition time equals concentration, temperature, pressure, and flow rate for isooctane-air mixtures
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Titanium alloys appear to be best for Mach 2.7 supersonic transport airframes
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Small-circle grid technique provides a rapid method of measuring strain magnitude, direction, and distribution developed during drawing JL66-3-57 660483

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> Alloy Steels Carbon Steels Stainless Steels

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Stirling engines show great potential for marine applications
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Variable sweep wings and deflected thrust cruise pure lift engine combination optimizes V/STOL performance JL66-1-32 660249

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### Submarines

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New casting technique strengthens turbine components
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Better ways of manufacturing parts made from such hard-to-handle materials as the refractory metals, titanium, and high-temperature adhesives IL66-12-58 660850

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Fuels refined especially for high-temperature supersonic flight afford advantages for subsonic operation if certain problems can be solved JL66-5-38 660520

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Noise level of supersonic transport will be no problem, according to all predictions JL66-2-54 660261

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British commercial vehicle design is being tailored to international operating requirements II.66-12-36 660846

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Variable sweep wings and deflected thrust cruise pure lift engine combination optimizes V/STOL performance JL66-1-82 660249

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### Thermoelectric Conversion

Radioisotope power for spacecraft applications continues to grow JL66-5-48 660523

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Four new front-wheel drive cars have been introduced in Europe in 1966. More fast-back coupes are appearing JL66-2-32 660256

Tests show that tire inflation pressure is the single most important factor determining tractive force in dual and tandem wheel drives
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New machining, milling, drilling, and weld-

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Titanium alloy appears to be best for Mach 2.7 supersonic transport airframes
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At high speed car size is chief factor determining fuel economy II.66-4-37 660498

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Gas turbines, better traction and brakes

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New casting technique strengthens turbine components
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Single crystal alloy extends turbine blade service life four times JL66-8-36 660806

Radioactive krypton techniques succeed in temperature mapping of turbine blades where other methods fail JL66-8-56 660812

Development of high-temperature materials for turbine engine blades and disc makes 20 F gain yearly JL66-10-66 660831

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Fluid system works – may be best way to control gas turbine engines

JL66-5-74

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Coordinated Evaluation Program helps reduce cost of small gas turbine controls
JL66-8-79 660819

### Turbine Engines

see also:

### Turbojet Engines

Design of complex turborotor systems with controlled vibration characteristics
JL66-2-44
660257

New design techniques promise extended turbine engine life for next generation of aircraft. Aircooling of hot sections is now mandatory

Formula rates turbine powered race cars	The state of the s	Vehicle Design
JL66-3-69 660488	Ultrasonies	Adapting vehicle and highway to suit visual
	Ultrasonics facilitates forming and joining	limitations of man can bring big safety
Feasibility of turbine conversion for pro-	JL66-6-72 660564	dividends
pane-natural gas fueling demonstrated on		JL66-8-44 660807
Westinghouse W-92 gas turbine	Ultrasonic welding techniques now permit	
JL66-4-86 660515	previously incompatible alloy combinations	Vehicle Directional Control
Y	to be joined	Variable-stability auto tests behavior of
Use of a gas turbine auxiliary power unit	JL66-7-48 660622	vehicles before they are built
aboard the Boeing 727 is proving a success, but knotting problems have been experi-		JL66-1-88 660251
enced	V	
JL66-7-60 660625	Vacuum Processing	Vehicle Performance
3130-1-00	Vacuum degassed steel has better internal	Digital computer technique predicts ve-
A 200-kw gas turbine engine power pack-	quality plus three to four times the fatigue	hicle road performance before vehicle is
age, complete with controls, is now avail-	life of air-cast alloys	built, through analysis of vehicle compo-
able for continuous-duty or standby power	JL66-3-53 660482	nents
applications		JL66-1-101 660255
JL66-7-68 660628	Valves / Valve Mechanisms/	V.Lt.I. Cofeen
	Hydraulic pumps, motors, control valves,	Vehicle Safety
Volvo dual powerplant meets military ve-	and filters are being redesigned to meet	Despite advances, automotive engineers
hicle needs	operating requirements of European Mo- bile Equipment	face challenges in safety, air pollution,
JL66-7-71 660629	JL66-1-76 660246	maintenance and insurance costs, and met-
	J100-1-70 000240	als conservation
Development of high-temperature materials	New method predicts exhaust valve tem-	JL66-5-36 660519
for turbine engine blades and disc makes	peratures for diesels in design stage	General Motors facility produces artificial
20 F gain yearly	JL66-2-49 660258	heads, made of plastic and aluminum, for
JL66-10-66 660831	3200 2 33	auto safety tests
Townsestors indication points are aid to	High concentrations of calcium and/or	JL66-7-43 660620
Temperature-indicating paints are aid to gas-turbine designers	barium in lube oil reduces valve and valve	3200-1-20
JL66-10-82 660835	seat wear rates in gas engines	1967 passenger-car engineering trends
3200-10-02	JL66-4-53 660504	JL66-11-32 660836
Power Transfer system improves fuel econ-		
omy and braking in gas turbine applica-	Certain engine design parameters exert a	Pedestrian impacts measured in 10-40-mph
tions	direct influence on operating temperature	full-scale collisions
JL66-12-55 660849	of exhaust valves	JL66-12-76 660857
	JL66-4-80 660513	
Turbine Lubricants	De terrological to the state of	Vibration
Iodine lubricants come to the rescue of	By improving breathing and combustion	Ten ways to boost jet engine life and econ-
hard-to-lubricate metals	characteristics, Army engineers increased the output of 4A032 MS engine from 9.8	omy
JL66-4-34 660497	to 16.6 bhp	JL66-1-98 660254
	JL66-4-82 660514	
Two specific properties of oil which can	J100-F62 000314	Design of complex turborotor systems with
be used to classify them are discussed and	British fuel injection systems replace the	controlled vibration characteristics
some ways for the military to avoid oil	troublesome jerk pumps with accumulator-	JL66-2-44 660257
compatibility problems	driven pump plungers at each nozzle	End for ton assessment disadventages of
JL66-8-65 660814	JL66-6-40 660552	Ford flex fan overcomes disadvantages of viscous clutch. Gives maximum airflow at
		low speeds, reduces noise and horsepower
Turbine Trucks	Ford tests show the benefits of using oils	at high speeds
Gas turbines, better traction and brakes	with a CRC rust rating of 9.0 or above for	JL66-3-64 660486
are visualized for long-haul over-the-high-	reducing part wear	3230 0 0 1
way trucks in the next ten years	JL66-8-49 660808	Laboratory experiments using new instru-
JL66-11-74 660842		mentation can eliminate brake noise caused
	Overhead camshaft has many advantages	by friction lining and brake vibration modes
Turbojet Engines	for Pontiac Tempest engine	JL66-3-74 660490
Ten ways to boost jet engine life and econ-	JL66-11-69 660840	The second second second second second
omy	Proceedings of the process of the pr	How modern reliability analysis can pre-
JL66-1-98 660254	Vapor Lock	dict life of mechanical parts and spot areas
3200 270	CRC tests with high- and low-volatility	of needed reliability
How Eastern Air Lines reduced mainte-	fuels give results on passenger-car volatil-	JL66-5-56 660525
nance costs of Pratt and Whitney JT3C-12	ity tolerance at high speed and load	
jet engine with a corrective action program	JL66-5-43 660521	Mathematical models, aided by uniformity
JL66-4-74 660511	000021	experiments, show contribution of tire non-
300011	Variable Compression Ratio Engines	uniformity to vehicle shake
Two Stroke Cycle Engines		JL66-5-60 660526
	Variable compression ratio and a variable	Illegation to be a second
Light weight of gasoline engine achieved by design rather than by using exotic ma-	speed drive for a constant air input in a	Ultrasonic welding techniques now permit previously incompatible alloy combinations
by design rather than by using exotic ma- terials	diesel engine give constant horsepower at variable speed	to be joined
JL66-7-74 660630	JL66-4-44 660502	JL66-7-48 660622
300030	000302	000022

### VTOL Aircraft

Variable sweep wings and deflected thrust cruise pure lift engine combination optimizes V/STOL performance

JL66-1-82 66024

V/STOL aircraft cut delivery time, increase product availability in 500-mile range JL66-6-76 660565

Gas power transfer lessens lift loss for lift-fan aircraft JL66-10-56 660829

### W

### Warning Systems

Chrysler warning light system supplements regular gages JL66-6-66 660561

### Wear

Bearings made from certain ordered alloys and metallic compounds appear suitable for high temperature applications JL66-4-56 660506

### Welding

New machining, milling, drilling, and welding approaches are making titanium easier to live with

JL66-4-40

660499

Electronic packaging engineers develop new ways of fastening flat-packs to motherboards

JL66-6-53 660557

Ultrasonic welding techniques now permit previously incompatible alloy combinations to be joined

JL66-7-48 660622

McCulloch arc welder is lightweight and portable
JL66-8-76 660818

Better ways of manufacturing parts made from such hard-to-handle materials as the refractory metals, titanium, and high-temperature adhesives
11.66-12-58
660850

### Windshield Wipers

Delco designs windshield wipers on a digital computer
JL66-2-66 660265

### Windshields

New instrument reads glass curvature and wedge angle directly. Helps define cor-

rections needed to control double image JL66-4-77 660512

Adapting vehicle and highway to suit visual limitations of man can bring big safety dividends JL66-8-44 660807

Impact tests with 4-lb bird show Sabreliner windshields capable of protecting pilots from birds at 350 knots JL66-12-69 660854

### Wings / Aircraft/ see also:

### see also:

### Swept Wings

XB-70 technological advancements pave way for future aircraft design JL66-7-50 660623

Failure analyses point ways to cut U.S. Air Force accidents IL66-12-44 660847

### Z

### Zero Gravity

Both American and Russian astronauts report unpleasant sensations. Reactions to weightlessness needs further probing JL66-5-83 660532

# ABSTRACTS OF TECHNICAL ARTICLES

SAE JOURNAL - JANUARY THROUGH DECEMBER, 1966 - VOL. 74

660244 (JL66-1-72) Two New Ways to Set Fleet Crankcase Drain Periods. K. A. Frassa, R. K. Siegfriedt, and C. A. Houston, Mobil Oil Co. Two new methods are available to establish realistic crankcase drains for gasoline-engine-powered vehicles used in fleets. The membrane filtration insolubles procedure is one; the differential infrared analysis procedure, the other. Both these methods are based on engine cleanliness.

660245 (JL66-1-74) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. Personal integrity is every man's obligation, but it is essential for the man who leads. To attain it you must:

- Make integrity and ethics a basic policy.
- Develop a management attitude.
- Give your best advice consistently.
- After a decision is made, support it.
  Know where your time goes.
- Always ask yourself: "Is this what I should be doing now?"
- When you make a mistake, admit it.

660246 (JL66-1-76) Huskier Hydraulie Muscles for Europe's Mobile Equipment. Richard G. Peach, Hamworthy Hydraulics Ltd. Hydraulic systems powering today's mobile equipment in Europe must handle pressures and flow many times those of early postwar units. Modern equipment could hardly be as productive and reliable at it is without this hydraulic "muscle."

At first, war surplus aircraft units or existing industrial systems were converted to meet the specialized hydraulies needed on mobile equipment. But this did not work out too well. Mobile service often proved too tough for hydraulies that worked well in industrial applications. Pumps, motors, control valves, and filters needed random reengineering to meet heavy-duty standards.

660247 (JL66-1-79) White's Walk Will Aid Future Spacemen. Stanley Deutsch, NASA, Office of Advanced Res. and Technology. Astronaut Edward H. White's 20-min space walk last summer proved that man can function effectively in space. His spacegun and tether line will be the basis for near-future extravehicular activity equipment.

Astronaut White used a small, hand-held,

self-maneuvering unit (spacegun), which permitted him to depart from the spacecraft and propel himself about outside the vehicle. This unit used high-pressure oxygen gas, capable of imparting an acceleration to the astronaut of 6 fps². White used the unit to maneuver about freely outside the vehicle and to stop his motion at any point. He translated back and forth several times and demonstrated pitch and yaw maneuvers. He found that the use of short bursts was adequate and conserved fuel.

660248 (JL66-1-80) Plastics Take a Shine to New Electroplating Methods. E. B. Saubestre, Enthone, Inc. Technical and economic drawbacks formerly associated with electroplating of plastics have been overcome by three recent breakthroughs:

Surface conditioning methods which promotes good metal-plastic adhesion without preroughening.

• Extension of electroless copper bath production life up to 20 times previous maximums

 New plating solutions that are able to obviate buffing or burnishing operations on copper-plated plastics.

G60249 (JL66-1-82) Variable-Sweep Wing the Thing for Optimum V/STOL Performance. N. W. Boorer, and B. J. Davey, British Aircraft Corp. /Operating/Ltd.; and G. P. Sallee, Bureau of Naval Weapons. Variable-sweep wing gives both good subsonic and supersonic performance, with only a minor weight penalty. Deflected thrust cruise engine and pure lift turbojets or turbofans give lightest engine combination.

660250 (JL66-1-84) Rational Attack on Smog Today's Major Automotive Technical Challenge. John R. MacGregor, Society of Automotive Engineers, Inc. Experiences to date hold lessons for automotive and petroleum engineers. They should cooperate with legislators BEFORE laws are passed. Local problems differ. Approved manufacturers' antismog systems are being used on all 1966 production cars destined for sale in California.

660251 (JL66-1-88) Variable-Stability
Auto Tests Behavior of Vehicles Before They Are Built. Leonard Segel,
Cornell Aero. Lab., Inc.; and R. Thomas
Bundorf, General Motors Res. Labs. The
CAL-GMR variable-stability car is a 1956
Buick sedan that has been modified so it
can be made to adopt a wide range of
control characteristics. It was built by
Cornell Aeronautical Laboratory as part
of a stability and control research program
sponsored by General Motors Research
Laboratories.

This unusual vehicle can be made to handle like most present-day vehicles, as well as untried vehicle configurations – and tried configurations that have not been successful. Its range includes vehicles that are stable and vehicles that are divergently or oscillatorily unstable.

Its most important current use is in the search for optimum directional control characteristics. It can also be used as a test bed for new design ideas for conventional vehicles and as a tool in the search for new subsystems that could be added to conventional vehicles for the purpose of handling improvement.

The vehicle itself is unchanged, as far as its design parameters are concerned, except for the steering system. This has been modified so that the mechanical linkage between the steering wheel and front wheels may be disengaged completely in favor of two servomechanisms, which provide for control of front-wheel position and steering-wheel forces.

660252 (JL66-1-92) Small Tractor Hydrostatic Drive Poses Design Opportunities. Harley E. Bergren, Char-Lynn Co.; and Robert H. Witt, Wheel Horse Prod., Inc. Properly applied, hydrostatic drive can improve the work efficiency of small garden tractors, even though drive efficiency is less. But the hydrostatic drive has been slow in becoming a commercial reality for propelling small tractors. In its way have been such problems as:

· Difficulty of selecting an optimum sys-

tem from an almost infinite number of possibilities through use of hydraulics.

Problem of mass-producing, at satisfactory costs, the highly accurate and intricate components of a hydrostatic system.

 The lower overall efficiency of most hydrostatic systems compared with existing gear-train systems.

 Cost and efficiency objectives were often not achieved because the manufacturer failed to develop an uncompromised design to meet individual requirements.

660253 (JL66-1-96) Five New Techniques Improve Visual and Audible Inspection Swiftly and Automatically. Thomas A. Luther, Sheffield Corp. New inspection techniques for increasing product reliability and reducing product costs have been developed for:

1. Cam measurement.

Height measurement.
 Cylinder bore roundness.

4. Piston-pin hole and pin matching and assembly.

5. Ball bearing vibration detection.

660254 (JL66-1-98) Ten Ways to Boost Jet Engine Life and Economy. E. M. Eltis, and F. W. Morley, Rolls-Royce Ltd. Jet engine life can be increased by proper consideration of: turbine blade and nozzle guide van aircooling; component stress concentrations; vibration; foreign object damage; fuel control system; oil consumption; idling fuel costs; overhaul life; early failure detection and use of a lightweight booster engine.

660255 (JL66-1-101) Computer Idealizes Vehicle Design Through Performance Study. M. A. Ordorica, Dana Corp. A prediction of vehicle performance can be obtained with a digital computer by considering separately and collectively the engine and torque converter, the mechanical transmission, and the rotating inertia. These components are transformed into numerical equivalents, and the resulting data is then plotted.

660256 (JL66-2-32) Four New Front-Wheel Drive Cars Have Been Introduced in Europe. Maurice Platt, Engineering Consultant. The majority of small cars being built in Europe today particularly the high-volume cars – have either a front-engine front-drive or a rear-engine rear-drive configuration. The conventional configuration of front engine and rear drive predominates only in the larger cars.

There are, thus, for 1967, four new front-drive cars – of small to medium size – being produced, as well as one high-performance sedan with 4-wheel drive. In the conventional classification increasing numbers of 2-door fastback coupés are appearing, and one manufacturer is offering a general-purpose vehicle that combines the attributes of the sedan and the station wagon, or estate car.

Other design developments in the 1967 models include:

Compact integration of engine, transmission, and final drive-prompted by the front-drive trend.

 New unitized body structures being combined with subframes to carry mechanical units.

 More efficient utilization of space, as evidenced by the design of some cars with increased interior space, for the same external dimensions; in other cases the cars are being made lower and shorter, without passenger or trunk space suffering.

• Increased glass area and the use of curved side windows; smaller quarter panels.

660257 (JL66-2-44) Tame Menace of Turbine Vibration. Robert T. Bohm, Lycoming Div., AVCO Corp. To design complex turborotor systems with controlled vibration characteristics, an accurate representation has evolved. The upper beam represents the casing, the middle beam represents the gas producer rotor, and the lower beam is the power rotor. All levels are interconnected by the bearings and their support structure.

The technique of handling this complex representation is akin to the transfer function approach used by control-system engineers to describe the output of a complicated system in terms of the input and a transfer function. The transfer function represents all of the elements between the input and output points. The method is general and could be applied to systems having any number of beam levels and supports to obtain the frequency response and mode shapes of the system. The mode shape is particularly useful for extrapolating information about:

· Bearing loads.

vibration.

Vibratory stress for fatigue evaluation.

· Clearance between parts.

Sensitivity to various types of unbalance.
 Energy distribution for various modes—useful when trying to shift a troublesome

660258 (JL66-2-49) New Method Predicts Exhaust Valve Temperatures for Diesels in Design Stage. A. Stotter, Israel Inst. of Technology; K. S. Woolley, and E. S. Ip, English Elec. Co., Ltd. Engineers have long sought a way to calculate exhaust valve temperatures for diesel engines still in the design stage. Accurate heat-flow analysis would help them guard against fatigue, corrosion, and thermal stress failures by optimizing valve shape and material in advance. A new electrolytic analog process gives just the data they need to find a happy medium between opposing requirements of reliability and initial cost.

660259 (JL66-2-52) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. Because so much of what gets done depends on cooperative effort, seeking the cooperation of others is a necessity as well as a challenge. The engineer who moves fastest toward management is the man who gets work done most willingly by others when he is not a supervisor. He must learn:

• That real cooperation must be earned.

• To treat others as individuals.

• To show consideration and common courtesy.

- To have others be receptive to his views; he must be sure to understand theirs.
- That cooperation does not mean avoiding honest differences of opinion.
- To ask for needed assistance or advice.
  To look for results rather than credit.
- 660260 (JL66-2-53) Pitchline Velocity Is Yardstick to Transmission's PTO Ability. R. W. Wagner, Chelsea Products. Calculations show how the pitchline velocity of the transmission gear which drives a power take-off can be used to approximate capability of a transmission for driving various types of truck auxiliary equip-

660261 (JL66-2-54) SST Noise Level Will Be No Problem, According to All Predictions. Nathan Shapiro, and Harry Drell, Lockheed-California Co. The SST will meet FAA community noise limitations during take-offs and landings. Ground operations will also cause noise levels that fall within reasonable limits. Of course, these predictions are the result of a great deal of extrapolation from available current jet data...so they could prove to be optimistic.

660262 (JL66-2-56) Smooth Shifts Begin in the Lab. N. A. Nann, and F. H. Pinchbeck, Texaco, Inc. Full-scale, engine-driven, transmission cycling tests show that frictional failure of automatic transmission is caused by fluid oxidation and selective additive degradation. One significant clutch slippage occurs through excessive fluid frictional degradation, the original shift quality cannot be restored fully by using fresh fluid.

660263 (JL66-2-59) How Hydrocarbon Types Determine Smog-Forming Potential of Exhaust Gases. R. W. Hurn, Basil Dimitriades, and R. D. Fleming, Interior Dept., Bur. of Mines. Reducing exhaust hydrocarbon emissions alone does not guarantee a corresponding cut in air pollution. Chemical composition of the hydrocarbons, plus their overall proportion to nitrogen oxides, determines the photochemical reactivity, or smog-forming potential of exhaust gases.

tential of exhaust gases.

Commonly called a pseudochemical characteristic, reactivity is the product of numerous compounds interacting cumulatively to make smog possible. Though certain components of auto exhaust seem to affect reactivity more than others, no positive correlation between composition and reactivity exists as yet. Realistic control methods can hardly be developed until we have standards based on measurements that distinguish photochemically active from passive hydrocarbons.

660264 (JL66-2-62) New Angle on Aircraft Handling and Safety at Landing Speeds. C. H. Tuomela, Navy Dept. A flight-reference system, based on an angle-of-attack measurement concept, is being used by the U.S. Navy for carrier-based aircraft operations. Advantages over conventional pitot-static systems include:

• Visual display of plane attitude to pilot,

as sensed by an exterior rotating probe, to the pilot.

 Control of landing and approach speeds regardless of aircraft weight, bank angle, flap aettings, acceleration forces, and the number of the operative engines.

 Visible indication of the margin above stall for various kinds of flap configuration.
 Visual indication of flight conditions during take-off.

• Furnishing a primary reference for automatic throttle systems.

 Reliable differentiation at high altitudes between clear-air turbulence and onset of stall.

 Providing the pilot with a maximumendurance reference for optimum utilization of the fuel.

660265 (JL66-2-66) Deleo Designs Windshield Wipers on a Digital Computer. Vasil J. George, and Paul F. Doering, Delco Appliance Div., GMC. A small digital computer has increased the effective manpower of Delco's windshield wiper system design group by more than 30 per cent. Computer-aided design is the latest technique for minimizing lead time in developing optimal wiper linkages.

660266 (JL66-2-75) Very Low Cost Is Major Spee for Counterinsurgency Aircraft. Roderick C. Dennehy, Research Analysis Corp. A systems approach is indicated for a low-cost air transport system that the United States might supply to its allies for counterinsurgency use. Need for such a system grows as counterinsurgency comes to encompass military, political, economic, psychological and civil actions of a government. Timely transportation in counterinsurgency actions by allied, underdeveloped countries is now imperative both in military operations and civil action programs.

Suitable air transport can enhance the effectiveness of civil action programs in emerging countries threatened by Communist-inspired insurgency. Many missions will require suitability for both the civil action field and for combat operations.

660267 (JL66-2-76) Reader FEED-BACK on "Engineering Education Swings to Serving Needs of Society." Educators and engineers in industry discuss such subjects as differences between the scientist and the engineer, expansion of engineering horizons, engineering goals, student involvement in engineering problems, and curriculum needs for both research and design.

660268 (JL662-81) Pedestal Specially Tested in New Tandem Suspension Design. Ira Maxon, Dura Corp. The pedestal of a new tandem truck suspension was designed to avoid the failures everyone in the tandem suspension business has faced. It was stress-analyzed from every angle before, during, and after it was designed. This apecial attention was warranted because the pedestal is right where the greatest vertical load occurs, and it has to take a twist moment and a moment in a horizontal plane.

660269 (JL66-2-82) Device Spots Thermal Breakdown of Fuels at High Mach Numbers. F. Burggraf, and M. Shayeson, General Elec. Co., Flight Propulsion Div. A small-scale single-tube heat exchanger device measures fuel thermal stability by measurement of the fuel-side heat-transfer coefficient. The device steps beyond the conventional fuel rating test (visual comparison of varnish deposits) and measures important parameters of high Mach number flight. From these data is calculated the rate of decay of the heat-transfer coefficient due to varnish deposits, which is a quantitative measure of fuel thermal stability.

660270 (JL66-2-86) Torque Converter Optimizes Tractor Design. Elton B. Long, Case /J. I./ Co. The use of a torque converter can allow earthmoving equipment to operate with shorter cycle time and/or move more earth, for most conditions, than if it were supplied with a clutch. Such a vehicle will have more tractive effort, wider operating range, and more easily operated controls. Also, leas shock will be transmitted from engine to transmission with a torque converter. The converter also has advantages with a power winch.

660271 (JL66-2-88) New Silencers Quiet Turbine Exhaust Noise, L. S. Wirt, AiResearch Mfg. Co. of Arizona. New silencers, using laminar absorbers to complement proper system design, are optimizing suppression of gas turbine exhaust noise.

660272 (JL66-2-90) Multiple Fuel Feed Knocks the Knock Out of Diesels, C. P. Gupta, Roorkee Univ.; John Shipinski, O. A. Uyehara, and P. S. Myers, Wisconsin Univ. Multiple introduction of fuel in a compression-ignition engine, whether by pilot, Vigom, or manifold injection, suppressed knock and smoothed the combustion process in tests conducted at the University of Wisconsin. A prechamber engine with a standard ASTM-CFR adjustable compression ratio, cetane rating, swirl chamber, and an open-chamber engine with a Mexican hat shape in the piston crown were used in the tests.

660476 (JL66-3-32) Japan's Exploding Auto Industry Is Now Fourth Largest in World. Robert D. Walker, SAE Journal. Japan's automotive industry, having expanded more than 5000 per cent since 1950, now ranks as the fourth largest in the world. In 1964, annual production reached 3,892,858 units of cars, trucks, buses, specialty vehicles, and two-wheelers. The proportion of passenger cars built has grown from 18 per cent (78,598 units) of total production of vehicles other than 2-wheelers in 1959 to 32 per cent (579,660 units) in 1964, and represents a volume increase of approximately 750 per cent.

This production explosion has been accompanied by greater sophistication in engineering design and styling. There is a pronounced trend toward larger and more powerful vehicles, but the greater part of Japanese production continues, from economic necessity, to be devoted to small, light vehicles. Japanese exports totaled 40,863 vehicles in the year 1959. The 1964 figure ran 744,623, which was an increase of more than 1800 per cent.

660477 (JL66-3-42) Multigrade Oils Lose Viscosity with Time and Engine Speed. J. P. West, and T. W. Selby, Dow Chemical Co. Multigrade oils showed a permanent viscosity loss of 8-20.4 per cent at 210 F, in 7.5 hr, according to tests made by the Dow Chemical Co. This 7.5 hr duration test is the equivalent of driving 385 miles at an engine speed of 2000 rpm. At 0 F, most of the oils showed a smaller percentage loss in viscosity. In addition, the loss rate is directly proportional to engine speed, but engine load has little or no observable effect on oil degradation.

660478 (JL66-3-44) Computers Use Discrete Element Approach to Struetural Analysis Problems in Aircraft Design. Melvin Stone, Paul H. Denke, John K. Matlock, and Charles R. Strang, Douglas Aircraft Co., Inc. The discrete element approach to structural analysis problems is an important technique in achieving programming generality. A general programming approach is necessary because of the high cost of special purpose programming. Other techniques that are needed to provide a computing system with the desired capabilities are: vector and matrix algebra to provide communicability and flexibility; the FOR-TRAN computer language to provide universality; and the digital computer itself to provide efficiency. Two examples of this general purpose computer system are the Douglas Redundant Force Analysis (RFA) method and the FORMAT program.

660479 (JL66-3-46) Survey of Automobile Drivers Yields Standardized Data on Driver Eye Location. James F. Meldrum, Ford Motor Co. Standardized data on driver eye location, an important parameter in car design, has been obtained from a joint industry survey, carried out with the help of personnel of the Manikin Subcommittee of the SAE Body Engineering Committee. The results differ from those given in SAE J906, Automotive Safety Glazing Manual, which was produced before the present survey was conducted. The J906 recommendation was based on manikin eye position and seat travel limits. It thus provides a broad indication, rather than refined percentile figures, for eye location.

Ellipse-shaped tangent cutoff pecentile contours, referenced to car body inch-lines and to points on the mankin have been developed. At the same time that eye locations were recorded, top-of-head locations were also determined. A photogrammetric technique was used to generate these anthropometric measurements for 2355 subjects. Three different car models used in the tests resulted in somewhat different answers.

660480 (JL66-3-50) Landing Gears Come Equipped with Headaches. William W. Witt, United Air Lines, Inc. Landing gear problems are often hereditary. They occur with each new model offered to the airlines when they could be greatly reduced by a change in design practice.

Here are five changes and procedures the airlines would welcome:

- 1. Provide nice, large radii.
- 2. Use scratch tolerant material.
- 3. Reduce the number of joints.
- 4. Use bushings in all static and dynamic holes.
- 5. Permanent part identification

660481 (JL66-3-52) "So You'd Like To Be a Supervisor." James E. Boyce General Motors Corp. Before you can set work objectives for others, you must know your own. Joint planning with your supervisor is one way to define these. Highest priority items immediately ahead should be listed, along with a brief plan of how to achieve them, and when major steps should be completed. Future revisions can be made as new circumstances develop.

660482 (JL66-3-53) Degassing Improves Quality, Extends Fatigue Life of Steel. A. A. Conrad, C. W. Darby, and R. T. Morelli, Crucible Steel Co. of America; John S. Adams, and Daan Troost. Bearings Co. of America. Largely free from flaking and internal rupturing in large ingots and forgings, vacuum-degassed steel features ideal properties for critical applications such as large steam turbine or generator rotors. Other characteristics make it equally valuable for smaller-scale high-load uses such as in bearings, where fatigue tends to limit the life of ordinary steels. Among its characteristics are:

- Reduced content of gas and nonmetallic inclusions.
- More homogeneous structure.
- Better alloy composition control.

660483 (JL66-3-57) Critical Strain Limit Prediction Can Upgrade Sheet Stretchability. Stuart P. Keeler, Great Lakes Steel Corp. Strain distribution measurements and analyses, based on a small-circle grid technique, provide rapid laboratory or on-line prediction of critical strain limits of materials to be stretched or drawn. Applications can result in increased stretchability of materials by increasing the uniformity of strain distribution. Problem areas which can be improved by utilizing the technique include material properties, die geometry, and lubrication.

660484 (JL66-3-60) Hold Down Turbine Operating Cost by Lengthening Part Life. John C. Pirtle, General Elec. Co. Turbine engine performance and size requirements demand acceptance of inlet temperatures in excess of what materials can stand. Therefore, material temperatures must be held down to a tolerable level for long life and the practical way to do it, while retaining the benefit of high cycle temperature, is to employ aircooling.

Cooling air for blades is routed around the discs to allow them to operate at minimum thermal gradients. This alone tends to increase the low cycle fatigue life of these parts. The reduced radial thermal gradient in the disc lessens the combined rotating-thermal stress cycle and so increases the low cycle fatigue capability of these parts.

660485 (JL66-3-62) Backhoe Reliability Increased by Laboratory and Field Tests. A. S. Tobiassen, Ford Motor Co., Tractor Div.; David L. Stevenson, and Eugene R. Whitacre, International Harvester Co. Backhoe reliability and design can be optimized by laboratory and field testing all of the individual components and the entire backhoe package. Laboratory testing, for example helped locate the swing cylinders for maximum advantage. Chain, linkage, or other flexible connections can be used to transmit the force of the linear swing cylinders to the swing post. These connections must be kept in tension at all times to prevent undue shock loading in accelerating or decelerating the elements during the swing cycle. The lab tests showed that the swing cylinders could be mounted to take advantage of this tension. The swing cylinders are located in their axial position by piloting the rod packing nut in a bulkhead, with the tension load applied directly to the gland to transmit the force.

660486 (JL66-3-64) Flexible Blade Fan Simplifies Engine Cooling. R. L. Cassidy, Ford Motor Co., Eng. and Fdy. Div.; and T. Z. White, Ford Motor Co. An engine cooling fan having five flexible steel blades which vary their pitch with engine speed has been developed by Ford to replace the viscous clutch fan and has been introduced on the Galaxie.

Having 70 per cent fewer components than the viscous clutch, and those parts stamped rather than precision machined, initial cost is lower. Warranty costs are expected to drop because the simple spring action of the fan should give it infinite life. A third advantage is a 30 per cent reduction in weight on the water pump shaft. The fan has three major components - the hub or spider, the blade, and the cap plate. The blades are made of SAE 1050-1060 spring steel, heat-treated in a neutral atmosphere furnace for maximum strength and endurance. The cap plate was added to reduce stresses around the rivets. The low-carbon steel hub provides the major structural strength of the fan. On the spin pit test no deformation occurred at 10,000 rpm and no rupture until a speed of 11,600 rpm was reached.

660487 (JL66-3-66) Propane Puts the Heat on Truck Engine Ignition. G. M. Galster, D. A. Garner, and E. D. Buckley, Champion Spark Plug Co. Dynamometer tests of a 361 cu in. truck V-8 engine show three major differences between gasoline and lpg ignition:

 Propane conversion works best on spark plugs one range colder, with gaps 0.005-0.010 in, smaller.

2. Sparking voltage requirements are higher for lpg operation, placing a premium on good ignition system maintenance. 3. Plug tip temperatures vary far more widely from cylinder to cylinder on propane than on gasoline.

660488 (JL66-3-69) Formula Rates Turbine Powered Race Cars. Peter Spear, Rubery, Owen and Co. Ltd.; and Noel Penny, Rover Co. Ltd. Probably the simplest scheme by which gas turbine powered cars are matched with piston engine powered cars for competitive racing is that used at Indianapolis. There, any size gas turbine engine is invited to compete. The obviously unfair advantage this gives to the turbine powered machine is somewhat eliminated by the formula adopted by the French Automobile Club de l'Ouest for the Le Mans 24-hr race. This formula estimates the turbine engine's power from the minimum area between the fixed blades of the first stage of the high pressure turbine. The reasoning behind this is that the mass flow depends on this area and the engine power, in turn, depends upon the mass flow.

660489 (JL66-3-73) Computer Applications Growing with Growth in Management Thinking. Stanley S. Miller, Harvard Univ. Industry's use of the computer for purposes other than data processing is growing at a rapid rate. Four significant trends in management thinking accounting for a large part of this growth

 Using computers for control concepts such as critical path methods and information feedback.

 Adoption of computers for speed and flexibility in systems analysis.

• Reviewing and optimizing the man-ma-

• Greater understanding of the computer, as well as its uses.

660490 (JL66-3-74) Laboratory Techniques Sound Out Brake Noise. B. R. Teitelbaum, and C. B. Sung, Bendix Corp.; and W. C. Suttle, Bendix Corp., Bendix Prod. Auto. Div. Laboratory tests using new instrumentation to study lining friction characteristics and vibration modes of self-energizing drum brakes show that brake squeal can quite often be eliminated by:

 Not using lining materials exhibiting negative slope in certain parts of the friction force versus speed curve.

 The utilization of a lining material having very large friction characteristics at the shoe rim edges near the leading ends of the brake shoe.

660491 (JL66-3-78) TV, Models, and Mosaics Used to Grade Space-Maneuvering Abilities. Carl R. Adams, R. D. Dunlap, and R. L. Batterton, Douglas Aircraft Co., Inc. An electronic vision simulator is being used to evaluate the capabilities of men in a space environment to perform flight control and surveillance tasks. Called an Earth Surveillance and Rendezvous Simulator (ESARS), the device presents a telescopic view of space and earth as seen from a spacecraft. The operator, within a simulated spacecraft, is provided with simulated dynamic control of maneuvers through system-connected

analog computers. Results show extent and limitations of men and equipment.

660492 (JL66-3-80) Use of Critical Path Method Simplified by Introduction of CIRCLE Notation, Overlap Features. W. Lyle Meyer, Illinois Univ. Two of the most recent developments in the Critical Path Method are:

CIRCLE notation - an improved diagramming technique.

• Operation overlapping - allowing dependent operations to overlap in time.

The CIRCLE diagram, unlike the original operation-on-the-arrow CPM diagram, requires no extra "dummy" operations or events to describe the logic of the project, and the operation numbers can be assigned before the diagram is drawn.

The operation overlapping technique allows the CPM analysis of the project without an excessive amount of breakdown of the project pieces.

660493 (JL66-3-84) Balanced Diesel Fuel Gives Best Fleet Economy. H. R. Hultkrans, Mobil Oil Co. Fleet performance and economy can be improved by using diesel fuel with properly balanced physical characteristics. Most diesel fuel characteristics are interrelated because of their dependence upon diesel fuel molecular type and size. So it is possible that if one property improves until it is outstanding, it does so at the expense of others.

Once a refinery has established its specifications for key properties such as cetane number, pour and cloud points, viscosity, and distillation range for a particular crude and processing scheme, little can be done to change the resultant API gravity of the fuel. However, operation of a diesel engine is not limited by API gravity, so too much emphasis should not be placed upon this property. The discussion describes these properties, how they are measured by laboratory tests, their roles in diesel performance and economy, and how they are interrelated.

660494 (JL66-3-88) Will Stirling Co H<sub>2</sub>O? F. E. Heffner, General Motors Res. Labs.; and R. J. Meijer, Philips Res. Labs. Marine applications could increase the use of Stirling engines. Quieter and more efficient than conventional powerplants, Stirling engines could be used in either surface or subsurface operations. Replacing conventional seals with the rollsock seal helps to optimize engine design.

660495 (JL66-3-90) Long-Life Clutch Material for Rugged Service. Edward W. Drislane, Bendix Corp., Marshall-Eclipse Div. Cerametalix friction material, developed originally for aircraft multirotor disc brakes, has undergone development to create a highly wear-resistant material for spring-loaded as well as overcenter-type clutches for farm and earthmoving equipment. It has also been tested in several trucks.

660496 (Jl.66-3-92) SNAP 10A, First Reactor in Space. Richard A. Johnson, William T. Morgan, and Sol R. Rocklin, Atomics Intl. The first nuclear reactor space power system, SNAP 10A, has provided information on a new type of space power system capable of producing power with a high degree of reliability, as well as giving answers to technical questions that are not readily attainable from ground testing.

660497 (JL66-4-34) Iodine Lubricants Come to the Rescue of Hard-to-Lubricate Metals. Robert S. Owens and Richard W. Roberts, General Elec. Co. Iodine lubricants appear to offer a solution to the lubrication problems being experienced with certain heat-resistant metals and alloys required in supersonic planes, spacecraft, turbines, and nuclear powerplants.

These materials, which include titanium, stainless steel, and nickel- and cobalt-base alloys, possess high strength and corrosion resistance at high temperatures. But they have one serious problem that often hinders their fabrication and use: they are extremely hard to lubricate. Rubbed together, they tend to gall and seize.

But now General Electric has developed a new approach to this lubrication problem, involving the use of iodine complexes as the active ingredient in the lubricant. This substance reacts with the metal at the rubbing interface, producing diiodides that have a lamellar crystal structure. Such a structure possesses a plane of low shear strength, that, when subjected to a stress, easily slides in one plane, much like a deck of cards.

660498 (JL664-37) Car Size Chiefly Responsible for Low Mpg at High Mph. Jack J. Cornell, Chrysler Corp. The major factor in high-speed fuel economy is car size, Chrysler evaluations show. Car components associated with performance, convenience and comfort have only a small effect on fuel economy at high speeds.

660499 (JL664-40) Advanced Fabrication Techniques Are Taming Titanium. Roland L. Guerin, S. Slomiak, and S. Schneider, Republic Aviation Corp.; and L. M. Crawford, Boeing Co., Aerospace Div. New techniques are improving the quality of titanium fabrication – and, in many cases, reducing the costs associated with such fabrication. The following report gives recent developments in the machining, milling, drilling, and welding of titanium.

660500 (JL66-4-42) "So Yon'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. Each major objective deserves some kind of plan of action. Engineers frequently prepare plans in connection with specific engineering projects. Planning is no less valuable or necessary for objectives that have supervisory or personal emphasis.

660501 (JL66-443) Computer Simulation of Diesels – the Pros and Cons. K. J. McAulay, International Harvester Co., Constr. Equip. Div.; Tang Wu and Simon K. Chen, International Harvester Co.; Gary L. Borman, P. S. Myers, and O. A. Uyehara, Wisconsin Univ. Advan-

diesel engines include:

Scientific thinking.
Rapid results possible.

- · Complete set of test data. • Single variable studied.
- Systematizes and preserves experience and data for future use.

• Optimizes engine development.

· Analysis of losses.

Computers, however, are no panacea. Limitations also exist. Some of these are:

 Simple assumptions. · Certain input data required.

· What, but not how.

· Simplest configuration required.

660502 (JL66-4-44) Constant Hp Diesel Now a Reality. S. G. Timoney, Dublin Univ. A constant horsepower, variable speed diesel can now be built. This is made possible through the use of:

· A variable speed drive between the engine crankshaft and a scavenge blower designed to provide a constant engine air input at full load over the entire speed range. · A variable compression ratio mechanism to control mechanical stress conditions caused by the constant air charge at the variable speeds.

660503 (JL66-4-48) Two Devices Help Evaluate Performance of Fuels for the SST. Kenneth C. Bachman, Esso Res. and Engrg. Co. The Esso Heat Transfer Unit and the ASTM-CRC fuel cokers help in the development of SST fuel by showing:

• The effect of temperature on fuel proper-

• The effect of deposit formation and type on heat transfer with time.

• The effect of temperature and fuel quality on deposit formation.

Four different fuels, with widely differing properties, were utilized in these tests.

660504 (JL66-4-53) High Additive Lube Adds Life to Engine Valves and Valve Seats. Howard M. Wiles, Waukesha Motor Co. High additive lube oils reduced valve and valve seat wear rate to 1/3-1/5 in gas engines according to tests conducted by the Waukesha Motor Co.

660505 (JL66-4-54) Application of Tri-Drive to 4-Axle, On-Off-Highway Truck Posed Critical Loading Problem. A. N. Schuppert, White Motor Co., Lansing Div. The first thru-shaft is the most highly loaded internal component of the 3-driving rear-axle combination developed for 4-axle trucks. The No. 1 axle of this unit has a standard tandem axle interaxle differential. The critical condition occurs when this differential is locked out. Then, the amount of power supplied to each of the three axles is based on the demand of each axle. Since the axles are loaded equally - 1/3-1/3-1/3 - No. 1 axle gets one-third of the available engine power, so that two-thirds is carried via the first thru-shaft back to the second and third axles. (When such a differential is used in a regular tandem axle, the thrushaft, of course, carries only one-half of the available power.)

660506 (JL66-4-56) Unconventional

tages attributed to computer simulation of Bearing Materials Give Uncommonly Good Performance. Mukul W. Mukherjee, Midwest Res. Inst. Ordered alloys and intermetallic compounds with a lattice structure that gives low shear and high hardness may prove more suitable than conventional materials for use in bearings in high-temperature aerospace and automotive applications because:

• They exhibit superior fatigue life and creep resistance.

• They have sufficiently low friction coefficients and wear properties so that, under some conditions, bearings made from them need not be lubricated. This property makes them usable at temperatures so high that ordinary fluid lubricants break down.

Powder metallurgy can be utilized for efficient fabrication at low cost.

660507 (JL66-4-59) Crew Holds Key to Reliability of Long-Mission Space Vehicles. J. W. Griswold and R. C. Schneider, Boeing Co., Aerospace Div. System restoration through maintenance is the important key to a technique for attaining the extremely high reliability required by manned space vehicles designed for very long mission times. The traditional redundancy approach, even with extensive redundancy, will simply not be adequate for missions that may last up to several years.

The system restoration technique makes full use of the "man-in-the-loop," allowing him to detect any failures, make decisions on alternate operating modes, switch to alternate equipment, or replace or repair and check out failed equipment.

660508 (JL66-4-64) New Hydrostatic Transmission Replaces Gearbox. C. L. G. Worn, Dowty Hydraulic Units Ltd.; and A. C. Walker, Dowty Technical Dev. Ltd. The Taurodyne hydrostatic transmission, developed specifically for industrial and farm tractors, permits using full engine power throughout the torque and speed range, the same objective sought through more sophisticated mechanical transmissions. It has passed field tests and now approaches production.

The transmission uses the tilting head principle for pump and motor, arranged so as to provide a compact, low cost unit. One feature is the tubular links which connect and control relative displacement of pump and motor and provide a short flow path from the primary oil circuit between pump and motor port plates.

660509 (JL66-4-66) New Tractors Designed for Bigger More Versatile Jobs. Robert W. King, Massey-Ferguson, Inc.; W. S. Coleman, R. L. Kunz, L. E. Vaughan, and T. A. Krattley, Mineapolis-Moline, Inc.; and R. E. Dreyer, Case /J. I./ Co. Driver comfort, pto's exceeding 100 hp, and better traction under drawbar pull are features of the large tractors being introduced to do faster, more efficient tilling, cultivating, and harvesting on today's kingsize farms.

660510 (JL66-4-72) Engine Knock - an End-Gas Explosion. W. W. Haskell, Shell Oil Co., Wood River Res. Lab.; and J. L.

Bame, Shell Oil Co. Knock, in a sparkignition gasoline engine, is caused by an explosion of the unburned (end) gases ahead of the flame front, according to recent tests. Theoretically, these explosions are probably caused by an autoignition of the end-gas initiated by small temperature gradients. This appears to refute the beliefs that knock is caused by either an acceleration of the normal flame front or by a detonation process.

The tests were carried out with a splithead CFR engine, equipped with a welldefined and isolated end-gas zone. An oscilloscope with a 50 cm/millisec sweep, triggered by contact of the flame front with an ion gap, gave single-cycle pressure-time diagrams of very high resolution.

660511 (JL66-4-74) Down Went Turbine Failures and Maintenance Costs. S. L. Higginbottom and R. S. Stahr, Eastern Air Lines, Inc. Eastern's experience with the Pratt & Whitney JT3C-12 turbine engine proves that the rating of a new engine has great economic significance. It also makes plain that if, a given engine is to be used on two different aircraft with widely different route patterns, and both fleets are to be maintained from a common overhaul-repair production line, then the aircraft with the more arduous duty cycle (shorter average stage lengths) must use a lower maximum power rating. Otherwise the short-haul engine will dictate maintenance programs for both fleets.

The JT3C-12 on the Boeing 720, which provided the case history, is an uprated version of the Pratt & Whitney JT3C-7, having a slightly higher rotational speed for added airflow and some turbine parts made from advanced materials to cope with substantially higher temperatures.

660512 (JL66-4-77) Windshield "Ghosts" Can't Spook This Meter. M. J. Irland and V. L. Lindberg Ford Motor Co. To control double images in auto glass, engineers must know its radius of curvature and wedge angle. A new instrument, the local curvature and wedge meter, gives these measurements faster and more accurately than previous laboratory methods. As a result, secondary image brightness and separation can be predicted for any glass design.

660513 (JL66-4-80) To Keep Valve Temperatures Down Pay Attention to Design Details. J. M. Cherrie, TRW, Inc., Valve Div. The most important factors influencing valve temperatures in modern engines are:

· Fuel/air ratio.

· Shape of exhaust valve head.

· Arrangement of valves in the cylinder head.

· Compression ratio.

· Valve stem-to-guide clearance.

· Abnormal combustion conditions.

660514 (JL66-4-82) Army Engineers Put More Punch into a Field Power Package. John M. Clark, Jr. and Douglas J. Skinner, Southwest Res. Inst.; and Raymond F. Dennis, Army Engr. Res. and Dev. Labs. By modifying the valve gear, adding a hemispherical cylinder head, new pistons, and a new intake system, Army engineers raised the maximum power output of the 4A032 MS engine from an actual 9.8 bhp (rated 10.6 bhp) to 16.6 bhp, at 3600 rpm. (This is an output increase of 77 per cent). In addition, brake specific fuel consumption decreased from 0.85 to 0.69 lb/bhp-hr, a savings of 19 per cent. Further refinements are expected to boost the output to a 17.2 bhp goal, the maximum feasible.

660515 (JL66-4-86) Gas Turbines Thrive on Dual-Fuel Diet. Derek J. Newton, and Bernard W. Lancee, Trans Canada Pipe Lines, Ltd. Without sacrificing performance, the Canadian Westinghouse W-92 natural gas turbine has been successfully modified to burn liquid propane fuel. Because stable combustion demands that the turbine be started on natural gas, dual-fuel nozzles must be used. Other changes required in the fuel control and machine protection systems include:

• A propane manifold.

• Propane fuel throttle, plus isolation and vent valves.

• Sweep air system for utilization with propane and gas manifolds.

 Electric sequencing to accomplish automated fuel changeover.

660516 (JL66-4-90) Facts for Diesel Fleet Operators Who Want to Save Fuel. J. A. Joyner, Cummins Eng. Co., Inc. The long-haul fleet operator can improve fuel economy in diesel-powered trucks by following these rules:

1. Do not operate at a cruising speed of more than 55 mph.

2. If using a van trailer, make sure the frontal area is no larger than needed for the loads to be hauled.

3. Choose accessories on the basis of efficiency for actual requirements.

4. Choose an engine with enough power to deliver cruising horsepower when operating at 85-90 per cent of maximum speed (rpm) with less than maximum throttle.

5. Keep installation losses low.
6. Select the transmission and rear axle so the engine operates at near maximum brake specific fuel consumption for the

cruising speed of the vehicle.
7. Train drivers so they will know how to drive for best fuel economy.

8. Establish and carry out a good preventive maintenance program.

Of course, maximum fuel economy is not always compatible with other requirements . . . so there are times when compromise is necessary. A number of factors to consider, as well as further rules for fuel economy are elaborated upon immediately below.

660517 (JL664-95) Decrease Tire Inflation Pressure, Increase Tractive Force in Tractor Applications. J. B. Liljedahl, Purdue Univ.; Stanley J. Clark, Colorado State Univ.; and David L. Apple, Decre and Co. Recent tests at Purdue University on the effects of single, dual, and tandem wheel drives showed that:

 Dual tires outperformed single tires for the same normal load when tested on loose soil, but were less efficient, even with lower tire pressures, when tested on firm soil.

• A 60-40 weight distribution using equal size tires and a 25-75 weight distribution using unequal size tires for the tandem drive outperformed the other weight distributions tested. Lowering the tire presure in either case resulted in better performance on both the loose and firm soil.

660518 (JL66-4-98) Reliability Team Guards Product Quality. Vernon Schafer Jr. Detroit Diesel Eng. Div., GMC. A team of engineers and support personnel contribute toward maintaining product reliability at Detroit Diesel. The team's function is to provide communication and foster cooperation between all departments concerned with the design, manufacturing, and end of use of the company's products. Automatic data processing decreases the time lag between problem recognition and corrective action of the problem.

660519 (JL66-5-36) Engineering Challenges Ahead as Seen by Management. James M. Roche, General Motors Corp. The automobile industry is willing and able to meet its responsibilities to the customer and to the public in general. It is responsible for building ever safer cars and trucks. Its products must provide maximum utility. They must also be durable, reliable, and dependable. Public officials with a legitimate interest in the automotive industry are entitled to the industry's cooperation.

The automobile industry has accepted these responsibilities. The record will show that it has met them. It will bear comparison with that of any other industry. We expect to maintain it in the future.

In this future, as in the past, automotive engineers must meet many of the most important challenges faced by the industry.

• Engineers must bear an important share of the responsibility for designing and building ever safer cars and trucks.

 Engineers still have a long way to godespite the great progress accomplished in unraveling the complex chemical puzzle involved in reducing air pollution from motor vehicles.

 Automobile maintenance costs need to be reduced - by greater simplicity in design, by providing greater accessibility, and by continued improvement in reliability and durability.

 Engineers must meet part of the challenge of rising insurance costs, too. Insurance costs are influenced by design, as well as by accident and labor rates.

• Conservation of metal supplied - through better reclamation of scrap - is a continuing challenge to the engineering effort.

660520 (JL66-5-38) High-Temperature Fuels Pose Problems in Subsonic Environment. John A. Hager, Air Force Aero Propulsion Lab. The use of hightemperature supersonic fuels in subsonic operation offers two big advantages, as far as military logistics is concerned:

 Refueling capability. Until a supersonic refueler is developed, it would be advantageous for a subsonic refueler to be capable of using high-temperature fuel.

• Loitering. Future mission profiles include subsonic loiter, followed by high Mach number dashes. This imposes a low-temperature environment on the system, followed by the high temperatures produced by supersonic operation.

A fuel designed to have this dual operating capability must meet very strict high-temperature, low-temperature, and fuel pumpability requirements, and some compromises in the fuel composition will be required.

660521 (JL66-5-43) Vapor Lock Studies Compare 1962-1964 Car Characteristics. H. A. Bigley, Jr. Gulf Res. and Dev. Co.; C. J. Domke, American Oil Co.; and H. T. Niles, Ford Motor Co. Half of the 1964 cars tested by the Coordinating Research Council's Motor Volatility Group had a limiting vapor pressure (at a 25 per cent increase in acceleration time) equal to or less than 8.9 psi at 100 F ambient temperature with a high-volatility fuel (fuel A) and 10.4 psi with a low-volatility fuel (fuel B). In terms of 1964 fuel volatility at a 20/1 vapor/liquid (V/L) ratio, comparable values for 1962 cars are 8.4 psi with fuel A; 9.7 pai with fuel B.

These were some of the results of the tests conducted at the Yuma Proving Ground during the fall of 1962 and 1964. Representatives of 27 organizations participated. Volatility tolerances of thirty-six 1962 and forty 1964 models were evaluated at 100 F ambient temperature (nominal) during accelerations from 15 to 80 mph following hot soak. Cars tested were those believed to be the most critical with respect to vapor lock.

660522 (JL66-5-44) Motors That Don't Mind Sea Water. F. D. Gaylord, Allis /Louis/ Co.; Robert J. Flaherty, and Wendell C. Phillips, Navy Marine Engrg. Lab. Since the advent of the nuclear submarine, greatly extended undersea operations have become commonplace. A loss of main power during one of these extended operations would obviously be quite serious. This problem has led to the development of two types of secondary propulsion units, both of which are capable of undersea operation.

One of the units uses a squirrel cage induction motor. The other is a motor-pump combination which uses the rotor-stator surfaces as a water-lubricated journal bearing. Both units are located outside the pressure hull of the vehicle, which helps reduce pressure hull weight so that it can be made thicker (and heavier) for still deeper divir.g.

660523 (JL66-5-48) Radioisotope Power for Spacecraft Applications Continues to Grow. Edward T. Mahefkey, Jr. and David F. Berganini, Air Force Aero Propulsion Lab.; David Elias, and Ivan L. Gray, Martin Co., Nuclear Div. Radioisotope power subsystems can potentially satisfy space power requirements in the 0.1-10 kw range. Many factors must be taken into consideration, however, before the final choice of a particular isotope can be made.

In addition, power conversion technology must keep pace with radioisotope developments. Thermionic conversion promises the best combination of low weight and high efficiency. Dynamic units give very high efficiencies, especially the braytonargon cycle. Use of thermoelectric devices appears to be limited.

660524 (JL66-5-55) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. You may not always do the selecting of individuals for assignments, but someone has to. On the other hand, there will probably be times this is your responsibility. You may have to assign either the whole or part of an employee's job. Then it is important to:

Review job assignment requirements.
Assess the qualifications of the individ-

uals available.

• Match individual qualifications with job requirements.

Consider employee development and interest, plus work group flexibility.
Determine who gets the assignment.

• Give assignments that challenge, but can be handled successfully.

660525 (JL66-5-56) Probabilistic Reliability Techniques Predict Part Life. Gehard Reethof, and G. W. Weber, General Elec. Co., Large Jet Engine Dept. Modern reliability analysis, using probabilistic techniques, can accurately predict part life and increase initial reliability.

As an example, consider the case of an alternator mounting bracket. This bracket is to hold the alternator cantilevered from the jet engine's front frame. It must be stiff enough to keep the alternator from hitting adjacent structures, but not so stiff that it causes excessive stresses on neighboring engine frame elements. The problem is aggravated by the fact that the natural frequency of the alternator-bracket assembly lies in the frequency band traversed by the jet engine as it comes up to speed.

660526 (JL66-5-60) When a Vehicle Gets the Shakes the Tires May Be the Culprits. Donald L. Nordeen, and Richard E. Rasmussen, General Motors Res. Labs. Analysis of mathematical models and uniformity experiments indicates that vehicle shake, one of the forms of vibration arising from tire nonuniformities (1) comes primarily from radial and lateral force variations, with the amplitude of the first harmonic of these force variations being of primary importance, and (2) the force variations should be measured on a large roll st rated load.

G60527 (JL66-5-67) New V-Belt Design Uses 60-Deg Sheave Angle for Improved Performance. Kenneth G. Custer, Gates Rubber Co. New, cast-polyurethane V-belts, using a 60-deg sheave angle system, have greater capacity, in the smaller sizes, and give a longer life than conventional 36-deg sheave angle belts.

660528 (JL66-5-70) SST Traffic Control Problems Are Being Investigated by Joint NASA-FAA Simulator Pro-

gram. Richard H. Sawyer, Langley Res. Center, NASA; Joseph P. O'Brien, Federal Aviation Agency; Ray D. Kelly, and George T. Henderson, United Air Lines, Inc. Air traffic control problems that may be met when the supersonic transport becomes operational are being studied by a joint NASA-FAA simulator program. Initial tests have consisted of simulated departure and arrival operations of a variable-sweep SST configuration in the New York terminal area under high-density traffic flow conditions, with as many as six supersonic transport operations per hour.

660529 (J 66-5-72) Analyst Sees Oil Seal Life as a Function of Load, Not Luck. Robert V. Brink, Victor Mfg. and Gasket Co. To know and control lip temperature is essential to successful oil seal performance. And high lip temperature is a result of the high friction horsepower that comes from excessive radial load (the sum of central-acting forces around the seal lip). The resulting leakage may come from any of several causes. It appears that radial load is of primary performance in achieving good oil seal performance. And, fortunately, the seal normally manages its own load problems quite well.

Works; May Be Best Way to Control Gas Turbine Engines. Richard J. Reilly, Honeywell, Inc. The special capabilities of fluid devices make them attractive components of a closed loop control system for gas turbine engines. Feasibility of such a system, in breadboard form, has been demonstrated by Honeywell on a General Electric J85 engine operating at sea level conditions between idle and 100 per cent power settings.

Fluid devices will never match the speed of their electronic counterparts, but neither do they need the control technique of measuring easy-to-obtain secondary parameters and then computing inferentially those really required for control of the engine. The basic engine control developed by Honeywell does not rely on prescheduled control parameters; the environmental capability of the fluid devices permits direct measurement of the required parameters. Thus, fluid devices allow major advances in control of gas turbine engines.

660531 (JL66-5-82) Polysulfone - New Plastic for Car Makers. R. K. Walton, Union Carbide Corp., Plastics Div. The rigidity, strength, and toughness of polysulfone thermoplastic resin, and its retention of dimensional integrity and loadbearing ability over a temperature range of -40 to 300 F, makes its a candidate for many automotive end-uses. These include electrical insulation and screw fasteners.

660532 (JL66-5-83) Inside Story of the Astronauts. William M. Helvey, Lockheed Missiles and Space Co. Although no astronaut has suffered serious impairment of health, weightlessness is the environmental factor causing greatest concern in space flight. Russian scientists think it may be the major problem in prolonged flight, especially the response to re-entry accelerations following the weightless experience.

660533 (JL66-5-84) Jerkmeter Traces Automatic Transmission Shift Performance. Robert L. Anderson, and Robert L. Bierley, General Motors Res. Labs. The jerkmeter was developted by General Motors Research to:

 Produce a detailed characterization of automatic shift performance.

 Measure the effect of various fluids on automatic shift performance.

Study the effect of changes in fluid characteristics with use on automatic shift performance.

The complete characterization of the shift performance of a particular transmission requires that measurements of upshifts and forced downshifts be made at various fluid sump temperatures and throttle settings. The jerkmeter can provide useful and detailed information about these shifts.

660534 (JL66-5-86) Military Air Progress Hinges on More Than Speed. Hans Multhopp, Martin Co. Now that aircraft can be developed for any speed between zero and orbital, a determination of the optimum usable speed for a specific class of airplane must be made. Speed for speed's sake alone is impractical.

660535 (JL66-5-88) Educators Split on Degree Aims of Preliminary Goals Report. Norman G. Shidle, SAE Journal. Recommendations of the preliminary "Goals of Engineering Education" report of the American Society for Engineering Education that are stirring most discussion are those that consider a 5-year master of engineering the first professional degree; make the bachelor's a preliminary degree. Educators' attitudes as well as analyses differ.

660551 (JL66-6-36) Tube Transportation - A Forward Look. Russell M. Lewis, Rensselaer Polytechnic Inst. A proposed high-speed, enclosed-tube transportation system would use a form of internal propulsion, where thrust is generated by a continuous transfer of air from immediately in front to the rear of the vehicle, to reduce power requirements. Vehicle support would be of some form of ground effect and aerodynamic suspension. The use of electricity for power would greatly reduce the problems of ventilation and air pollution. No insurmountable problems in operation and control are expected. The system described was invented by Professor J. V. Foa and has been under study at Rensselaer Polytechnic Institue for several years.

660552 (JL66-6-40) Accumulator-Pressurizing Widens Fuel-Injection Operating Range. W. P. Mansfield, British Internal Combustion Eng. Res. Inst. Ltd. A new fuel-injection system, developed by the British Internal Combustion Engine Research Association, replaces mechanically driven jerk pumps with a gas-loaded hydraulic accumulator and pump plunges at each cylinder nozzle. Evaluation tests

show that the new system provides:

• Optimum performance over a wide range of engine speeds and loads.

· Accurate injection timing, fuel quantity, and rates with consistent repeatability.

· High reliability, long service life, and, in addition, ease of maintenance.

660553 (JL66-6-46) Titanium Alloys Best for Mach 2.7 SST Airframes. Roger V. Carter, Boeing Co., Airplane Div. Titanium alloys, now economically available for routine design application, are the best choice for supersonic transport airframes. Major titanium characteristics leading to this conclusion are:

 Strength-to-weight ratio considerably higher at pertinent temperatures than other materials of comparable toughness

· Good corrosion and stress corrosion resistance in SST environment.

· Good fatigue properties and metallurgical stability.

· Good fabrication properties and raw material availability in the required primary

660554 (JL66-6-47) "So You'd Like To Be a Supervisor." James E. Boyce, Gen-eral Mo'rs Corp. Assigning work prop-erly is easier said than done. The following points may be helpful.

· Brief the employee on the project before he gets the assignment.

• In giving an assignment, explain what is needed, when, and why.

· Convey other job specifications and useful background information.

· Within reason, let the employee propose alternate methods.

· Agree on the plan of action and check-

· Delegate enough authority to get the job done.

· Do what you can to help.

660555 (JL66-6-48) Lawnmower Rides on Air Cushion. Vernon J. Worrel, Toro Mfg. Corp. The principle used in the ground effect machine has been applied successfully to a rotary-type lawnmower. Developed by a Swedish inventor, it is now being made here, under license, by

The unit employs a centrifugal, or radial flow fan, with backwardly curved blades to provide sufficient air pressure to support the machine. Power source is a 5.1 cu in., single-cylinder, 2-stroke, aircooled engine.

660556 (JL66-6-50) Combustion Effects at High Bmep Are Demonstrated with Single-Cylinder Research Engine. Simon K. Chen, and Patrick F. Flynn, International Harvester Co. In tests conducted by the International Harvester Co., using a high-bmep, single-cylinder, compressionignition research engine, the following results were observed:

• Combustion - Increasing manifold inlet temperature and density ratio (ratio of manifold density to atmospheric density) smoothes combustion. Increasing engine speed roughens combustion.

· Volumetric efficiency - Increasing manifold inlet temperature and decreasing piston speed increases volumetric efficiency. Increasing intake and exhaust valve effective flow area also increases volumetric effi-

• Performance - Increasing density ratio increases gross indicated mean effective pressure (gimep).

• Friction - Increasing the peak cylinder pressure and the mean piston speed increases the rubbing and accessory friction.

The two primary reasons why a singlecylinder engine was chosen in preference to a multicylinder engine to run the high brake mean effective pressure investigations are:

1. Need for a minimum number of development parts saves cost and time.

2. Cylinder-to-cylinder variation is eliminated, since there is only one cylinder in a single-cylinder engine.

660557 (JL66-6-53) Electronic Packaging Engineers Develop New Ways of Fastening Flat-Packs to Motherboards. Norman I. Cohen, Speery Gyroscope Co.; and John R. Sosoka, Unitek Corp. Two new ways of putting electronic systems together have been developed that provide increased flexibility and also reliability at a reasonable cost.

The Sperry method solves some of the problems caused by the small components used by means of a carrier-motherboard, rack approach, plus interconnected wire-wrap techniques. The Weldmatic approach uses an automatic welding technique that is able to affix the flat-packs directly to the printed circuit motherboards.

660558 (JL66-6-59) Mack Selects MIL-Spec Gear Oil with Limited Slip Additive for Heavy-Duty Power Divider. W. R. Alexander, Mack Trucks, Inc. Tests of 40 different gear oils have shown that oils meeting the requirements of MIL-L-2105B, and containing limited slip additive are the only ones giving adequate lubrication for the heavy-duty power divider used in Mack Trucks.

660559 (JL66-6-60) Charts Tell Highway Vehicles How Much They're Offtrack. Hoy Stevens, Samuel C. Tignor, and James F. LoJacono, Bureau of Public Roads. Direct reading and calculation of off-tracking values for almost all practical highway vehicles and trailer combinations can be made with the use of recently developed charts. The charts give offtracking data for turns of 90 and 270 deg and for outer front wheel turning radii of 25 to 225 ft.

660560 (JL66-6-62) Neither Ice Nor Cold Nor 23 Years Can Keep Aircraft Hydraulies from Doing Their Job. Arthur B. Billet, Vickers, Inc. Cold, wet weather has no deletorious effects on the condition and performance of aircraft hydraulic systems and components, even after 23 years. This conclusion was reached by investigators of the Long Term Storage Panel of the SAE A-6 Aerospace Fluid Power Technologies Committee, after late 1965 inspection and testing of hydraulic equipment from the USAF B-17, "My Gal Sal," which crash-landed on the Greenland icecap in June, 1942.

660561 (JL66-6-66) Chrysler Warning Light System Supplements Regular Gages. Henry M. Merker, Chrysler Corp. A single warning light indicating possible trouble caused by:

• Oil pressure below 10 psi

• Coolant temperatures above 240 F • Fuel supply below a predetermined level is used on the Chrysler Imperial, in addition to the regular gages. The warning

light, when illuminated, simply reads, "Check gages."

This Sentry Signal Warning System - as it is called - thus combines the advantages of gages, which can forewarn a driver of trouble, and also indicate its severity, with the attention-getting effect of a warning light. The light, however, operates completely independently.

660562 (JL66-6-68) Spontaneous Ingition Time of Isooctane-Air Mixtures Can be Predicted, Wayne G. Burwell. United Aircraft Corp.; and Donald R. Olson, Pennsylvania State Univ. Spontaneous ignition time of an isooctane-air mixture is inversely proportional to equivalence ratio, temperature, and pressure and directly proportional to airflow rate.

660563 (JL66-6-70) New Long-Life Elastomers for Molded Automotive Parts May Help Extend Auto War-ranties. William R. Leach, Goodrich /B. F./ Chemical Co. Two recently developed polyether elastomers, a copolymer of epichlorohydrin, Hydrin 200, and a homopolymer, Hydrin 100, offer good resistance to ozone, acids, bases, water, heat, and flame, and excellent resistance to swelling in oils and fuels. The copolymer is the more useful of the two as it combines these properties with a true low-temperature flexibility and an excellent resiliency. Such properties should make these elastomers more satisfactory than some present specialty rubbers in many automotive applications.

660564 (JL66-6-72) Ultrasonie Motors Fabricate Metals and Plastics. Lewis Balamuth, Cavitron Ultrasonics, Inc. Ultrasonic motors can be used to join metal to metal, metal to plastic, and plastic to plastic. Cold-forging of metal can be done at reduced static force. Some industrial applications already in use are ultrasonic joining of plastic sheets, and welding and soldering of metals. Other applications are under development.

The thermal equivalence principle has been developed to explain the action of materials when high acoustic energy is pumped into them. It should also prove helpful in foreseeing possible areas of application of ultrasonics to solids, and in assessing the possible effects to be exnected.

660565 (JL66-6-76) V/STOL Aircraft Cut Delivery Time, Increase Product Availability in 500-Mile Range. George B. Pearson, Ling-Temco-Vought, Inc., Vought Aero. Div. The delivery speed and door-to-door availability of cargo for

distances of 500 miles or less are greatly increased with the use of V/STOL aircraft. Also, they can effect a significant cost savings in the transportation of all but extremely low value items.

660566 (JL66-6-78) Engineers Share "Goals" Concern for More Continuing Education. Norman G. Shidle, SAE Journal. An emphatic need for continuing education, stressed in the ASEE preliminary Goals of Engineering Education report, is the new document's most direct tie to industry concerns. But individual automotive engineers are applauding the emphasis at all engineering education

• Problem solving ("mastery of the engineering method" - defined as "using the full powers of the mind, imaginative as well as logical, with no holds barred").

• Design-oriented as well as research-oriented curricula.

• The humanities and social sciences.

• Improved communication skills.

660567 (JL66-6-82) Economical Fuel for Both SST and Subsonic Aircraft Is Here Now. Arthur V. Churchill, John A. Hager, and Alan E. Zengel, Air Force Aero Propulsion Lab.; Richard P. Foster, and Eldon M. Sutphin, Gulf Res. and Dev. Co. The use of three hydrogen processes, hydrofinishing, hydrotreating, and hydrocracking, are making available high-quality fuel for both SST and conventional aircraft operations.

660568 (JL66-6-84) New Casting Technique Strengthens Turbine Components. B. J. Piearcey, and F. L. VerSnyder, United Aircraft Corp., Pratt and Whitney Aircraft. The ductility, thermal shock resistance, and other properties of nickel-base superalloy, Mar M-200, have been greatly improved by a new precision casting process. The superiority of the properties of the new material has successfully been demonstrated in both laboratory and turbine engine tests.

The nickel superalloys used in turbine blades, when cast, commonly fail along the grain boundaries normal to the direction of the applied stress. The new directional solidification process produces complex turbine parts, both blades and vanes, with long columnar grains oriented parallel to the axis so that the transverse grain boundaries, and hence the source of failure, no longer

exist.

660569 (JL66-6-88) Sonic Booms of SST May Prove Unacceptable to 25 Per Cent of People Affected. After six months of subjection to eight sonic booms daily, 25 per cent of Oklahoma City people felt they could not learn to accept the booms. This is one outstanding conclusion of FAA-sponsored tests in which 2.0 psf over-pressure was the highest achieved - and that in only 22 per cent of the booms during one-week phase of the tests. (Minimum sonic boom objectives for the United States supersonic transport: "no greater than 2 psf during acceleration and 1.5 psf during cruise for domestic operation.")

660618 (JL66-7-36) SAE Conversions Guide to Joint English-Metric System Use. Roy P. Trowbridge, General Motors Corp. To improve technical communication with automobile and aerospace engineers in metric-system areas, the SAE Technical Board officially has taken the following position:

• Technical committees under the Board shall use conventional U.S. measurement units in development of SAE technical reports. In recognition, however, of the need for better understanding and communication between the users of SAE technical reports in the U.S. and users elsewhere in the world, the Board encourages the practice of providing Systeme International (SI), that is, metric, equivalents of U.S. conventional measurement units in SAE technical reports where inclusion of such equivalents will better serve communications needs.

• SI equivalents shall be determined and used by technical committees in accor-

dance with stated rules.

660619 (JL66-7-39) New Diesel Combustion Chamber Gives Smoother Combustion and Cleaner Exhaust. W. Henry, Hupp Corp., Hercules Eng. Div.; and R. Herrmann, Hispano-Suiza. The Hispano-Suiza turbulence combustion chamher gives appreciably smoother combustion and cleaner exhaust than does the standard diesel direct-injection combustion system. The combustion chamber has a spherically shaped upper part, which is part of the cylinder head casting. The lower part, the combustion cup, has a concave portion that matches up with the spherical upper part of the chamber. The throat opening allows the entry and exit of the gases during the combustion cycle. The combustion cup is oriented by means of a dowl pin to assure proper location of the throat. The fuel nozzle is oriented toward the center of the turbulence chamber.

660620 (JL66-7-43) "Heads Up" for Auto Safety. A recent addition to the facilities at the General Motors Proving Ground is known as the "head factory." Its products are plastic and aluminum likenesses of the human face and skull, cast in special molds and finished at the rate of 4-5 per day for use in actual or simulated crash tests.

The artificial heads are being attached to anthropomorphic dummies in all types of full-scale crash tests. They can also be attached to the end of a hammer-like device that bangs them against samples of various energy absorbing materials of the type used on auto instrument panels,

This grim but purposeful routine is providing engineers with a steady flow of information needed to evaluate new materials and design proposals for eliminating or minimizing injury to car occupants involved in crashes.

660621 (JL66-7-46) Two Design Innovations Make Toronado Unitized Power-Drive Train Possible. W. A. Weidman, Oldsmobile Div., GMC; J. R. Doidge, General Motors Corp., Hydra-Matic Div.; and D. P. Marquis, Saginaw Steering Gear Div., GMC. The parallel engine-transmission configuration adopted in the Toronado necessitates a chain cross-drive to transfer power from the engine to the transmission. To alleviate congestion in the engine compartment resulting from this arrangement, a plantary differential unit is employed. When the power flows in the engine and the transmission are parallel, as in the Toronado, a connecting cross-drive is required. This drive must be as quiet and as durable as the drives in conventional vehicles. Such a crossdrive might have been obtained by using either gears or a chain. As gears proved to be both excessively noisy and difficult to align, a silent-type chain was chosen.

The silent link design results in a smooth engagement of the chain with the sprockets, allowing the links to assume the load gradually, thereby reducing impact.

660622 (JL66-7-48) Ultrasonie Vibrations Help Join Metals. R. Gellert, North Amer. Aviation, Inc., Rocketdyne Div. Two ultrasonic welding techniques currently exist. In one, ultrasonic energy alone is used. In the other, ultrasonic energy assists the conventional welding processes. Both techniques allow many previously unweldable metal combinations to be easily and economically joined. In addition, recent development of larger ultrasonic welders now enable small structural members to be joined.

660623 (JL66-7-50) XB-70 Technology Paves Way for Future Aircraft Design. Donald B. Rogerson, and Elbert S. Steele, North Amer. Aviation, Inc. The technology developed to meet the XB-70 performance requirements will find application in future high-performance aircraft and space vehicles for years to come.

Some of these technological advances

are in the areas of:

· Advanced aerodynamic concepts.

• Systems and equipment. • Engine inlet system.

· Materials and structure for sustained flight at speeds of Mach 3.

660624 (JL66-7-58) Convertible Plane to Carry People by Day, Cargo by Night. M. A. Hiatt, and K. C. Plewes, Boeing Co., Airplane Div. A completely new concept in aircraft interior design makes practical the transport of passengers by day and cargo by night. Its standard-appearing passenger interior can be converted to carry cargo in 20-30 min; reconversion takes same time.

Applied to a 20-ton-capacity jet airplane, capable of serving short-to-medium range regional markets, this new design concept has a completely palletized passenger in-terior, full-width cargo pallets, and a ground-and-airplane transfer system capable of handling and restraining both the passenger and cargo pallets.

660625 (JL66-7-60) On-Board Auxiliary Power Unit Pays Off for Boeing 727. William Murray, American Airlines, Inc.; and A. F. Bullard, United Air Lines, Inc. The on-board gas turbine auxiliary unit being used by American and United to make their Boeing 727's self-sufficient has proved a success, despite a series of problems. Among these problems have been a number of major ones, which required removal of the unit for repair or overhaul. as follows:

· Turbine wheel rub.

· Cooling fan failure.

· Compressor plenum gasket failure.

· Torus inlet wear.

· Plenum drain check valve failure.

660626 (JL66-7-62) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. From the supervisor's standpoint, "solve problems as needed" might be stated more accurately as: take part in the solution of problems. Whether a problem is essentially technical or personnel centered, many of the same principles apply.

· A problem is a barrier in the way toward an objective.

• Take an interest in employee work problems.

• The apparent problem may not be the real one.

. Don't state the problem in a way that implies or limits its solution.

· Hasty agreement may overlook a better colution

660627 (JL66-7-63) Endurance Limits Climb When Surface Stresses Are Boosted. Robert B. Liss, Charles G. Massieon, and A. S. McKloskey, Caterpillar Tractor Co. Water quenching produces high residual compressive stresses and results in much better fatigue strength for the medium carbon and alloy steels. But the quenching severity, degree of decarburization, tempering procedures, and the cross-sectional area of the steel piece are also significant in the development of these

660628 (JL66-7-68) Caterpillar Turbine Engine - A Complete Power Package. Robert E. Kennemer, Caterpillar Tractor Co., Indust. Div. A new 200-kw gas turbine engine power package has been developed by the Caterpillar Tractor Co. This is a complete unit, containing:

· Engine.

Reduction and accessory gearing.

· Engine controls and the starting system. · Air induction and exhaust system.

· Lubricating system.

Power generator.

This unit can be used in continuous duty applications where there is a demand for heat in addition to electricity. It can also be readily utilized in standby power appli-

660629 (JI.66-7-71) Volvo Dual Powerplant Meets Military Vehicle Needs. S. O. Kronogard, Volvo AB. A dual powerplant - consisting of a diesel engine combined with a gas turbine - has been developed for military vehicles. The combined powerplant is highly successful in demonstrating the advantages of both engines and minimizing their disadvantages. As a result, it also meets the requirements for military vehicles to a very high degree.

660630 (JL66-7-74) 3.5 Hp in an 8-Lb Package. Robert E. Perlewitz, Tecumseh Prod. Co. A new 3.5-hp, 2-stroke loopscavenged engine, for operating portable tools, uses a third-port induction system in place of the conventional reed valve design. This small single-cylinder engine weighs 8 lb and is capable of operating in any position. The design life is a minimum of 500 hr at peak performance with no maintenance other than spark plug replacement. The large bore to stroke ratio was dictated by weight and bulk considerations. Although detrimental to power output and fuel economy, the low effective pressure ratio allows easy starting.

660631 (JL66-7-76) Light Diesels Give Promise in Mail Service. George C. Nield, United States Post Office Dept. Diesel engines may soon be specified for the smaller trucks of the large Post Office Department fleet, as a result of a comprehensive study being made by the Department. Although the tests are not yet complete, interim findings indicate that: large savings in fuel are possible with the diesel vehicles, and acceleration is generally satisfactory. The one remaining serious problem, where improvements must be made, concerns the generally higher noise level of the diesel, compared with the gasoline engine.

660632 (JL66-7-80) Designing Fuels and Lubes for Extreme Cold. W. F. Ellison, and A. H. Scrimshaw, British Amer. Oil Co. Ltd. The choice of suitable fuels and lubricants for winter conditions in Western Canada is governed by the range of temperatures, conditions of snow and ice, and the "wind chill" factor.

In Western Canada the pour should be held to at least -35 F; for more northerly service -40 F. In both cases, the closer one can get the cloud point to the pour point, the better.

660806 (JL66-8-36) Single Crystal Alloy Extends Turbine Blade Service Life Four Times. F. L. VerSnyder, and B. J. Piearcey, United Aircraft Corp., Pratt and Whitney Aircraft. Nickel-base superalloy turbine parts have been cast as a single metal crystal of selected orientation. Since the resultant "Monocrystalloys" have no grain boundaries, the alloy may be designed to optimize the bulk properties without compromising the grain boundary properties. The new casting technique is reproducible, compatible with present foundry methods, and does not involve seeding. The single crystal parts have, as expected, far superior properties, especially with respect to creep and thermal shock, than both the conventionally cast and directionally solidified castings.

660807 (JL66-8-44) Adapting Vehicle and Highway to Suit Man's Visual Limitations Can Bring Big Safety Dividends. Paul L. Connolly, Visual Consultant. Analysis of current practice in vehicle and highway design shows that man's visual capabilities are often overtaxed in operating a modern high-speed automobile. Application of present-day phychophysiological knowledge leads to specific design recommendations in some areas, and pinpoints problems in others. Some of these areas are:

· Signal lights.

· Windshields. • Instrument panels.

· Fender hardware and fore-and-aft ridges as aids to orientation.

· Highway sight distance.

• Entrance and exit ramp design.

Centerlines and edge markings.
 "Freeway hypnosis" - visual fatigue that

is due to boredom.

660808 (JL66-8-49) Higher Rust Rated Oils Reduce Part Wear. George Puia, Fred Ghannam, and Roy Robinson, Ford Motor Co. Oils with a CRC rust rating of 9.0 or above reduced engine tappet noise and connecting rod bearing wear significantly over oils with a CRC rust rating of 7.0 or less. These were results obtained in tests conducted by the Ford Motor Co.

660809 (JL66-8-52) Warding Off Aircraft Enemies - Corrosion and Lightning. Alfred H. Wendelbo, Douglas Aircraft Co., Inc. Designers of jet aircraft have to distinguish, and provide protection from, eight types of corrosion. On the DC-8, for example, it takes about 350 lb of sealant material to do the job.

In addition, the designer must employ electrical bonding and electro-magnetic interference control to meet the problems created by the natural environment - static electricity and lightning, and by the induced environment, operation of electrical and electronic equipment, which produces transients, fault currents, and static elec-

660810 (JL66-8-53) Seven Trends Having Marked Effect on European Car Design. W. C. McDonald, Jr. Ford Motor Co. Trends foreseen in and affecting European automobile design include:

· Car size is moving upward, along with

the economy.

• Engine size and power are increasing faster than car size is increased. However, it will increase much faster if some of the existing license and insurance limitations are also eased.

· Econome necessity seems likely to force the reduction of elaborate mechanical designs, such as the front-wheel drives and the independent rear wheel suspensions.

• There will be a dramatic increase in the number of options available and sold on passenger cars (automatic transmissions, power assists, deluxe trim options, and the

• An increase in the number of European families owning more than one car will force a broadening of the spectrum of product appeal

• Important growth in the European highway system, which seems likely, will be a major stimulus to the trend toward larger and more powerful cars.

• Product-change cycles will become

shorter as the competitive pace increases in European countries.

660811 (JL66-8-55) Manifold Vacuum Operates Retractable Headlights. Robert J. Schultz, Oldsmobile Div., GMC. A vacuum-actuaced retractable headlight system is used on the Toronado. The actuators, each capable of applying a 200-lb pull to the hingle lever, ensure quick (approximately 6 sec) operation, even under icing conditions.

660812 (JL66-8-56) Radioactive Krypton Simplifies Temperature Mapping of Turbine Blades. Stanley F. Wisnieff, and Herbert Bardach, Lycoming Div., AVCO Corp. Radioactive krypton techniques optimize high-temperature turbine blade design through highly accurate temperature mapping.

These new techniques were developed because the local surface temperatures were difficult to measure, due to optical inaccessibility of the blades, and high rotational speeds, which precluded good transmission of thermocouple emf's through slip-rings. Also, the temperature levels anticipated were above the useful range of available temperature-sensitive paints. Metallurgical examination is only able to give very general conclusions regarding temperatures.

Krypton was chosen because of the availability of a suitable radioisotope, Kr-85, whose 10.6-year half-life, weak beta emissions, and chemical inertness make it an excellent choice from the vantage point of workability and safety.

The krypton may be introduced into the metal by ion bombardment, 2-5 key, or by forcibly diffusing the 5 per cent Kr-85, 95 per cent Kr-84 mixture into the metal in a pressure vessel held at 600 C for 48 hr. The aspect of the kryptonation process that gives it practical utility is that the krypton atoms are captive in the lattice structure of the material, and cannot be liberated unless the lattice cells are either physically disrupted, chemically altered, or spatially changed, as by abrasion, corrosion, oxidation, or heating.

Using heat as a means of liberation, three specific techniques have been developed. They are the:

- · Residual counting method.
- Gas evolution method.
- Ratio test method of approximation.

660813 (JL66-8-60) Mixture Velocity Differences Appear To Be the Major Cause of Cylinder Pressure Variations. Donald J. Patterson, General Motors Corp. The major cause of cyclic pressure variation in spark-ignition engines is the mixture velocity differences that exist within the cylinder, near the spark plug, at the time of ignition. But the magnitude of these variations may be reduced by increasing the combustion rate, through greater swirl and turbulence in the combustion chamber. These results were obtained from tests made by General Motors. In addition, it was found that poor mixture and distribution of the fuel, and the cyclic spark timing variations also contribute to the pressure variation problem, but they

account for less than one-third of the total pressure variation within a cylinder. Spark energy and rise time, spark-plug gap width and electrode configuration, and exhaust residuals have, however, an almost negligible effect on the cyclic pressure variation.

660814 (JL66-8-65) Categories and Compatibilities Are Problems of Synthetic Oils for Aircraft. John Wheatley, Boeing Co., Airplane Div. Synthetic lubricants for aircraft have reached the point in their development where they need:

Broad classification of the various generations of these oils . . . this classification to be determined by specific oil properties.
More realistic ways to avoid oil compatibility problems. Military operations, in particular, are prone to oil mixing problems. They can be relieved by supplying only one brand of oil for a particular area or, if mixing must be done, following strict compatibility testing procedures.

660815 (JL66-8-66) Balanced Electrical Circuits Improve Truck Reliability. Frank P. Plovick, Delco Remy Div., GMC. The reliability of a vehicle's most unreliable component, the electrical system, may be materially improved by an adequate balancing of the charging circuit components. The battery must be chosen so as to alleviate its two major faults, cycling and over-charging. However, the major step towards a balanced electrical circuit is the provision of generator capacity which is adequate at all engine speeds.

660816 (JL66-8-68) SAE Standards Program - What It Does, Where It's Going. Paul B. Benner, Caterpillar Tractor Co. More reliable transportation machinery at lower cost, simplified production, safety, better communication . . . these are the ends to which SAE standardization is the means. Any vehicle that moves under its own power falls within the province of the SAE program. Looking at the program today, and trying to envision its future reveals that with every year these activities must be expected to take on new dimensions and add new chapters.

Today, SAE standardization covers passenger cars, trucks and buses, farm and earthmoving machinery, marine propulsion units, airplanes (from helicopters to private aircraft to jet planes), and space vehicles – as well as the materials and components that go into them. SAE limits its standards strictly to the environmental and operating problems of these surface, air, and space vehicles. When standards that originate in SAE grow in usage beyond automotive interests, they are proposed to the American Standards Association as American standards.

660817 (JL66-8-74) Empirical Equations Define Aircraft Drag. J. E. Linden, and F. J. O'Brimski, Bureau of Naval Weapons. A set of empirical equations for predicting the subsonic minimum drag, the drag-due-to-lift, and the subsonic drag rise of various proposed jet aircraft designs has been developed. The equations are designed for use in the absence of wind tunnel test data on a particular model

aircraft. Estimates, based on these equations, correlated well with flight test results.

660818 (JL66-8-76) McCulloch Are Welder Is Light Weight and Portable. John H. Brooks, and Robert V. Jackson, McCulloch Corp. By marrying a high-frequency inductor alternator to a 2-stroke engine, McCulloch has created an arc welder weighing 55 lb, with an output of 170 amp.

The cylinder, cylinder head, and crankcase are made of a single aluminum die casting with a cast-in-place pearlitic castiron cylinder liner. Unlike the chain saw from which the welder grew, there is a single milled exhaust port instead of three drilled ports. The single port is 3 in. in circumference whereas the 3-port design was 5 in.

660819 (JL66-8-79) Coordinated Evaluation Program Helps Reduce Cost of Controls for Small Gas Turbines. Robert G. Moore, and Robert W. McGinnis, Bendix Corp., Bendix Prod. Aerospace Div. The cost of the complex controls required on small gas turbines can be effectively reduced if, in the very early design stages, the engine designer and the control specialist initiate a coordinated program for evaluating performance requirements versus costs. Costs should be obtained on special equipment, processing, and all items affecting initial investment as well as the eventual production costs.

Such a cost-reducing program can be carried out in the following steps:

- Definition of control requirements for all potential engine applications.
- Selection of control parameters, based on the control requirements.
- Study of accuracy requirements for each parameter.
- Trade-off studies to determine the best compromise between parameter selection, accuracy, and mechanization consistent with cost objectives.

660820 (JL66-8-82) Both Engineers and Car Owners Can Benefit from New Battery-Rating Method. Rine Kruger, and J. W. Barrick, Delco-Remy Div., GMC. Deficiencies in present methods of rating batteries have led Delco engineers to develop a method of power rating that, they claim, can:

• Give the application engineer a better indication of the ability of a battery to supply power to the cranking motor.

 Help the car owner obtain the correct replacement battery, when his old battery wears out.

Some of the advantages claimed for the new method of rating batteries are:

- It measures the maximum cranking power of all batteries.
- It will not require periodic revision as cranking loads change.
- It measures all batteries on an equivalent scale, so results can be directly compared. • It provides a meaningful one-number basis for comparing the cranking power of all batteries and also factors out the design variations and application differences.

Delco engineers do not feel, however,

that this method is actually the final answer to rating storage batteries. They hope, rather, that it will help to stimulate the development of new rating methods of greater versatility, which will give a more exact description of total battery behavior.

660821 (JL66-8-84) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. Everybody makes decisions of one kind or another, but the main concern here is with decisions made by engineers and supervisors. The following points, however, do apply to decision making in general.

• Devisions can be defined as choices between alternatives.

 Quality and acceptance are key attributes of decisions.

 Decisions requiring only high quality should be made by the person best qualified.

• Differing views can improve the quality of decisions.

 Decisions requiring only high acceptance can be improved by the participation of those involved.

 Decisions requiring both high quality and high acceptance call for supervisory ability.

• Timing is critical.

660822 (JL66-10-36) Electric Transmission with Individual Wheel Drive Proves Practical for Military Trucks. Walter Slabiak, Army Tank Automotive Center; L. J. Lawson, Robert P. Borland, and Clarence G. Puchy, Lear Siegler, Inc. A U.S. Army test truck has been proving that an electric transmission can increase vehicle efficiency, handling ease, and dynamic performance. For several years now this truck has been driven on test runs over both regular paved highways and rough cross-country trails. According to the engineers associated with the project, the test truck is superior to mechanical transmissions in all of these driving conditions.

The electric transmission has proved the ideal type for such rough-terrain driving. The built-in automatic controls relieve the driver from deciding when to change gears or whether one of the wheels is about to alip. The electronic gearing carries out the throttle commands of the vehicle operator in a smooth and continuous way. The system automatically detects impending wheel slip on each of the individual drive wheels (there are six on the test truck) and removes power from any wheel that starts to slip, usually well before the driver has even noticed it.

660823 (JL66-10-41) An Engine Powered Snow Shovel for the Home Owner. Byron L. Ertsgaard, Toro Mfg. Corp. To fill the void between the high-powered, heavy, and expensive snow thrower and the all-too-familiar snow shovel, Toro has developed a 22-lb shovel powered by a 2-stroke-cycle engine, with linear polyethylene for certain parts, and a special dual handle.

660824 (JL66-10-42) Unreliable SST's Could Shatter Airlines' Net Returns. N. R. Parmet, and W. D. Sherwood, Trans World Airlines, Inc. Interaction and cumulative effect of its reliability, operational flexibility, maintainability, and salability will determine the commercial practicality of the projected United States supersonic transport.

Current growth in propulsion system performance, both thermodynamically and mechanically, for example, can have a major influence on its earnings and useful life. Advancement of turbine engines into SST applications must not be accompanied by the same trend in maintenance as occurred in piston engine days. To provide a viable SST, mechanical reliability and maintenance capability must be improved by the designer.

Unreliability in all SST systems, in fact, is more economically significant than with subsonic aircraft. So, speed with which problems are recognized and corrected will greatly influence operating economics.

660825 (JL66-10-45) "So You'd Like To Be a Supervisor." James E. Boyce, General motors Corp. Delegation is not completed when an assignment is made. Proper follow-up and review are also necessary. This makes them supervisory responsibilities worth timely attention. In general, the better you have carried out the steps leading up to an assignment, the easier you can follow-up and review. Here are some tips to help you follow-up:

• Follow-up helps get things done.

 You need review to evaluate progress and aid planning.

• There are many ways to initiate and handle follow-up.

• "Looking over their shoulder" bothers people.

• Systematic, rather than random followups, is usually better.

• Criticize the situation and facts, rather than the person.

660826 (JL66-10-46) Tests Show Fuel Economy Effects of Car Design and Driver Factors. Charles E. Scheffler, and George W. Niepoth, General Motors Corp. The relationship between fuel economy and such factors as horsepower, vehicle weight, and ambient temperature; warmup economy and fully warmed-up economy; and city and highway operation has been studied extensively in tests at the GM Proving Ground.

Warmup economy of all cars can be compared, based on the percentage of fully warmed-up fuel economy that a car attains as warmup progresses. (Direct comparison of warmup economy of all different makes is impractical because of the large differences in the fully warmed-up economy values.)

660827 (JL66-10-49) Solid-State Circuitry Gives Breakerless Magneto Long, Trouble-Free Life. G. A. Guernsey, and E. J. Brayley, Globe-Union, Inc. A new flywheel magneto replaces the breaker points with a solid-state switch and a trigger circuit. Besides eradicating the disadvantages inherent in breaker points, the new unit possesses a longer trouble- and adjustment-free life.

The breakerless magneto was designed

to possess spark characteristics similar to conventional units and to have directly comparable output voltage and energy. The new magneto is also physically interchangeable.

660828 (JL66-10-52) Students, Industry, Educators Stress Varied Education Goals. Norman C. Shidle, SAE Journal. Goals of engineering education are not common to all higher education institutions, nor to all students who seek an engineering education. And they should continue to differ – if most executives and students contacted by this investigator are to be believed. A significant number of educators also subscribe to the desirability of a variety of objectives among schools to meet the great variety of needs apparent among students and throughout society.

Much of the heat generated in recently accelerated debates about engineering education goals arises from conflict between those who think common goals are possible and desirable, and those who don't. These current disagreements give every indication of continuing (and probably intensifying) unless disputants either:

• Confine discussions to generalities (which one educator brands as "straight motherhood"), or

 Agree that no single goal does, can, or should exist for all institutions engaged in the engineering education process.

660829 (JL66-10-56) GPT Lessens Lift Loss for Lift-Fan Aircraft. E. F. Beeler, and L. J. Volk, General Elec. Co. Control by gas power transfer is better than thrust spoiling for aircraft over 10,000 lb in gross weight which use lift fan propulsion systems for V/STOL flight. The gas power transfer system has much less lift loss than the thrust spoiling system, but still provides adequate aircraft control. Although the thrust spoiling system supplies fast fan dynamic response, use of a phase lead network (jazzer) in the control circuit of the gas power transfer system can do the same.

The XV-5A flight research vehicle, which is powered by the lift fan system shown, is controlled during VTO mode and transition by a thrust spoiling louver system. Although this system is relatively simple, it is inefficient because it requires that part of the available life be spoiled and held in reserve to supply pitch and roll control forces.

A gas power transfer system differs from a thrust spoiling system in that the gas power can be distributed among the fans by manipulation of the variable geometry of the turbine nozzles in the fan scrolls. The required control forces are thus provided, but with a smaller loss in lift,

660830 (JL66-10-63) Torsion Rubber Suspension for Tandem Axles Gives Better Truck Ride. Walter L. Luli, and Warren J. Young, White Motor Corp., White Trucks Div. The Torsilastic single-point, tandem-axle suspension features a torsion rubber spring, independent wheel action, high spring deflection, controlled axle movement, and maximum arm articulation.

660831 (JL66-10-66) High-Temperature Alloys for Turbine Engines Are Steadily Improving. W. H. Sharp, Connecticut Metallurgical Corp. Rotor blades in aircraft engines are currently operating at 1750 F metal temperature. Disc materials now withstand rim temperature up to 1350 F, while gains in sheet metal for ductwork are in the 1200-1600 F range. After years of research, evidence points to a continuation of a 20-F yearly gain rather than a hoped for "quantum jump."

660832 (JL66-10-69) Assuring Passenger Safety in Supersonic Flight. John P. Stapp, Armed Forces Inst. of Pathology. Countermeasures against air conditioning failure and explosive decompression in the supersonic transport flying at extremely high altitudes must be automatic. Aftfacing seats would give maximum protection in crashes while allowing closer protection.

660833 (JL66-10-70) Fuel Injection Increases Economy, Reduces Exhaust Emissions. J. H. Freeman, Jr. Pure Oil Co.; and R. C. Stahman, United States Public Health Service. Fuel injection can provide a modest reduction in fuel consumption and substantial reductions in CO emissions and hydrocarbon emissions, compared with carburetion.

660834 (JL66-10-76) Paraffinic Resins Have Dual Role as High-Temperature Lubricants and Viscosity Index Improvers. E. E. Klaus, and R. E. Hersh, Pennsylvania State Univ.; and J. M. Perez, Kendall Refining Co. The paraffinic resins are a unique group of high molecular weight fluids with high viscosity index and Newtonian properties, which may be prepared in either the conventional or superrefined form. The oxidative and thermal stabilities of the resins are such that they may be used alone as high-temperature lubricants. As V. I. improving additives in hydraulic fluids they are shear stable, retaining up to 99 per cent of the viscosity increase.

The search for improved lubricant and hydraulic fluid life led to the application of superrefining techniques, including deep-dewaxing, to viscous mineral oil (hydrocarbon) fractions. The most viscous mineral oils available for study under this process are the paraffinic resins derived from Pennsylvania crude oil. The conventionally refined (designated CR type) resins from which the superrefined (designated SR type) resins are derived cover a normal range of viscosity levels.

660835 (JL66-10-82) Temperature-Indicating Paints Are Aid to Gas-Turbine Designers. William H. Duffey, Allison Div., GMC. Temperature-indicating paints can now give gas turbine designers the precise knowledge of component temperature data they need. These paints are being used, with a high degree of accuracy and reliability, in the design and testing of combustion and turbine components.

By observing the paint coloration pattern after a test run, designers can ascertain a wealth of information on temperature levels, temperature gradients, and hot spots. To get the same data by conventional thermocouple methods is impractical, if not impossible. For the temperature-indicating paints, there have been developed improved bonding techniques, more color changes, and special procedures for preparing and handling the components to be painted.

660836 (JL66-11-32) 1967 Passenger-Car Engineering Trends. Walter G. Patton, SAE Journal. Analysis of 1967 passenger-car designs points to the following likely trends for the near future:

• Greater protection for driver and passen-

Satisfactory solution to the exhaust emission problem.

Higher horsepower and stepped-up performance.

 Economics and improved processing (including foundry techniques), machining processes, and assembly methods will continue to influence engine changes.

• Larger tires, new tire designs.

More reliable electrical systems.
 Improved flow-through ventilation systems.

660837 (JL66-11-54) Landings Are Less Rough with Double-Action Shock Absorbers. W. W. Williams, W. C. J. Garrard, and G. K. Williams, Lockheed-Georgia Co. Military transport aircraft nowadays must land on rough, unprepared airfields. So, the landing gear must be able to absorb the hard shocks induced by landing, taxiing, and take-off operations in these areas. This is achieved by using long-stroke, double-acting shock absorbers, combined with tires that have deep working sections. The double-acting shock absorber helps landing in assault areas in another way, also. . . . It increases sink speed capability within design load limits for STOL operation.

One aircraft whose landing gear design has been improved by the long-stroke, double-acting shock absorber is the Assault C-130. Studies show that the bump amplitude capability of the double-acting landing gear is two to three times the capacity of the present C-130 landing gear.

660838 (JL66-11-61) Students and Graduates Today Fall into Recognizable Patterns. Lee E. Danielson, Michigan Univ. Engineering students today are different from those of even five or ten years ago. No longer are they so single-minded that they feel their work is their life. Graduates fall into recognizable patterns.

660839 (JL66-11-62) Deere Makes Dual Use of English-Metric Units. George D. Mattison, Deere and Co., John Deere Water loo Tractor Wks. Parts for two tractor engines have been designed to permit dual usage of English and metric measurements. Planned for use and/or manufacture in the United States and overseas, the designs were such as to result in drawings easily convertible between English and metric systems.

660840 (JL66-11-69) Overhead Cam-

shaft Stirs New Tempest. M. R. McKellar, Pontiac Motor Div., GMC. One key feature of the new Pontiac overhead camshaft, 6-cyl Tempest engine is the neoprene rubber timing belt that drives the camshaft and all basic engine accessories. The teeth molded on the inside surface of the belt have a wear-resistant facing of neoprene-impregnated nylon fabric. Since the belt requires no lubrication, it is located outside the crankcase, where it engages the axial grooves of three surface-hardened cast-iron sprockets.

660841 (JL66-11-73) Permanent Antifreeze Is Not So Permanent. Eric Beynon, Union Carbide Corp., Consumer Prod. Div. Factory-fill, ethylene glycol base, antifreeze coolants deteriorate with time and service and should not be recommended for more than one-year use. Even then, there should be periodic inspection of both the coolant and the cooling system.

660842 (JL66-11-74) Callahan Forecasts a Decade of Change for Long-Haul Over-the-Highway Trucks. William E. Callahan, International Harvester Co., Motor Truck Div. The next ten years are certain to bring significant change to the entire range of over-the-highway trucks, from the lightest to the heaviest and from the multipurpose varieties to the most highly specialized applications.

660843 (JL66-11-78) Corrosion-Resistant Copper Alloy May Doom Steel Tubing for Hydraulie Brake Lines. B. J. Sirois, Phelps Dodge Copper Prod. Corp. Each year over 150,000,000 ft of steel tubing and no copper is used for hydraulic brake lines. But copper-alloy tubes can now be made with an initial strength that is scarcely inferior to that of steel, and with very much superior corosion resistance. This was shown in a study sponsored by the Copper Development Association, Inc., in which a battery of mechanical tests was applied to copperalloy and steel tubes before and after exposure in a salt-spray chamber. One alloy—copper with 1 per cent iron—seems ideal.

660844 (JL66-11-81) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. Only by utilizing results can you complete the cycle started by setting work objectives. Results may be greater than, equal to, or less than expected, but they should be put to proper

660845 (JL66-11-82) Vibrating Plows Reduce Cost of Burying Utility Lines. Louis A. Kemnitz, Glen P. Buck, and Lleyd F. Brisk, Illinois Bell Telephone Co. Two types of vibrating plows have been developed for making short, underground residential utility line installations at reduced cost, compared with conventional methods. One type employs a shaker, and the plowshare is vibrated vertically. In the other type, the plowshare is driven by a mechanical linkage to a crankshaft. It operates in a circular or elliptical path.

660846 (JL66-12-36) British Commercial Vehicles Are Tailored for Inter-

mational Operating Requirements. Maurice Platt, Engineering Consultant. A large export business is responsible for the development of commercial vehicles in Britain that are suitable for use all over the world, including spots where operating conditions are much more severe than in the United Kingdom. Important advances have been made in diesel engines, brakes, transmissions, power steering, suspensions, and tires. Maximum vehicle gross weights are up.

660847 (JL66-12-44) Failure Analyses Point Ways to Cut USAF Accidents. Richard J. Pennoni, Air Force Directorate of Acrospace Safety. Actions taken following specific failures point up design principles and policies need to improve reliability and safety of U.S. Air Force aircraft. Analyses of these cases show that safety features must be designed, manufactured, and tested into every airplane part. This conclusion applies to mechanical linkages, hydraulic systems, and electrical circuits. It applies also to major components, such as wings, control surfaces, and landing gear.

There are no precise limits to the degree of safety and reliability the Air Force needs and wants. But 1400 aircraft destroyed and 1500 lives lost during the past five years through accidents is too high. Metal fatigue, stress corrosion, and other technical problems like those described here contributed to destruction of 262 airplanes and loss of 339 crew members and pass-engineers during 1964 alone.

660848 (JL66-12-52) Closed-Center Hydraulic System Operates Rapidly and Efficiently but It Still Needs Refinement. William T. Stephens, Borg-Warner Corp., Warner-Motive Div.; and Herbert N. Underwood, Borg-Warner Corp., Roy C. Ingersoll Res. Center. A series of analyses and tests on a cross-section of hydraulic equipment has proved the superiority of the closed-center hydraulic circuit over the open-center type. For the same or less horsepower, the closed-center circuit is faster, more efficient, requires less peak power, and provides greater force to prevent stalling than its open-center equivalent. To increase operator safety, and remedy some of the inherent deficiencies, a refined closed-center circuit is proposed.

660849 (JL66-12-55) "Power Transfer" Improves Fuel Economy, Braking in Gas Turbine Applications. William A. Turunen and J. S. Collman, General Motors Res. Labs. The GM "power transfer" system is a major engineering advance in the design of gas turbine engines. It improves part-load fuel economy to a point that rivals diesel economy, and provides dynamic braking equal to the rated output of the engine.

Basically, "power transfer" is a hydromechanical method of transferring controlled amounts of power between the independent shafts of a 2-shaft gas turbine engine. One set of plates of a hydraulically actuated clutch is driven through suitable gearing by the gasifier turbine. The other set of clutch plates is geared to

the power turbine. The clutch torque can be regulated by means of the hydraulic pressure. The gear ratios are chosen so that the power turbine-driven plates turn slower than the gasifier turbine-driven plates during all normal engine operating conditions.

660850 (JL66-12-58) How To Use Materials in Aerospace Structures. E. W. Emmerich, E. D. Jacobs, and R. L. Jones, Northrop Corp., Norair Div. Many problems are being experienced by aerospace engineers as they try to substitute the little understood high-temperature exotic materials for the very well understood aluminum in aerospace structures. This situation has led Northrop to undertake a number of study programs designed to improve our knowledge of these materials and their use. Highlights from five of these programs are given here, as follows:

• Brazing of refractory metals.

· Titanium welding.

· Hot forming titanium alloys.

· Machining titanium and superalloys,

· Adhesive bonding.

660851 (JL66-12-62) Ford Automatic Transmission Uses Hydraulics and Air Cushions to Achieve Smoother Shifts. John W. Greer and George W. Schulz, Ford Motor Co., Transmission and Chassis Div. The Ford automatic transmission has two minor innovations designed to produce smoother gear changes. During the 1-2 shift, a unique hydraulic control regulates the application of the intermediate band to ensure the desired results. To eliminate the harsh engagement of the reverse clutch plate, a ball check valve maintains a cushion of entrapped air behind the plate.

660852 (JL66-12-65) What Are Engineers Really Like? Lee E. Danielson, Michigan Univ. First-line supervisors tend to see engineers as an impatient group. Higher management often thinks that engineers are a bright bunch, but not particularly loyal to the organization; that they would move to a better job tomorrow if it came along. Subordinates feel that engineers are lucky guys with degrees. Staff people often think engineers are loners. Individual engineers perceive their individual situations quite differently, depending on whether or not they are employed in one function or another.

660853 (JL66-12-66) Existing Field Data Aid Future Combine Transmission Design. Larry M. Delfs and Aaron M. Cuerington, Deere and Co., John Deere Harvester Wks. An empirical formula allows the designer the basic combine variables, to predict an effective axle torque for any operating speed, and hence, the life of any transmission component at that speed. A simple extension predicts the life at any speed and the speed at which minimum life occurs. The basis of the new formula is a correlation of all field data into a series of graphs.

The fluctuating loads on a combine transmission have previously been combined using the cumulative damage theory. However, this approach has, generally, been applied to problems on which specific tests were conducted. It was to eliminate the large number of tests necessary to simulate each operating condition, that the present procedure was developed.

660854 (JL66-12-69) Birdproofing the Sabreliner. C. W. King, North Amer. Aviation, Inc., Los Angeles Div. By shooting 4-lb, chloroformed, polyethylene-bagged birds at windshields of the Sabreliner, North American Aviation was able to evaluate and modify windshield construction to meet the qualifications for a Transport Category Type Certificate.

The birdproofing test setup included a motion picture camera (operating at 5000 frames per sec) which recorded the velocity of the "live ammunition," while dummies placed behind the windshield provided the means to assess damage from flying fragments.

660855 (JL66-12-72) Auto Uses Seen for PPO Resins with Constant Properties Over Wide Temperature Range. J. W. Robertson and P. Shenian, General Elec. Co. Polyphenylene oxide resins are a new class of thermoplastics that appear to be suitable for use in a wide variety of automotive parts because of:

 Good mechanical properties that remain relatively constant over the normal automotive operating temperature range.

 Serviceability in a wide range of aqueour environments.

660856 (JL66-12-74) New Ether Priming System Aims to Simplify Diesel Starting. Kenneth B. Owings, Spray Prod. Corp. A newly developed ether spray priming system for heavy-duty diesel engines has a spray nozzle that uses to best advantage the pressure of the nitrous oxide propellant that vaporizes the fuels.

660857 (JL66-12-76) Pedestrian Impacts Measured in 10-40-Mph Full-Scale Collisions. Derwyn Severy and Harrison Brink, California Univ. The shape and height of the front end of a vehicle as well as its resistance to deformation during impact with a pedestrian positively influence the forced movements of a pedestrian following impact and until he reaches his position of reset. Front ends having the shape of a horizontal wedge increase the upward projection of the pedestrian and, therefore, the subsequent injury potential on striking the pavement. Blunt front ends decrease upward projection but result in higher initial impact forces.

660858 (JL66-12-78) "So You'd Like To Be a Supervisor." James E. Boyce, General Motors Corp. It might seem superfluous to cite leadership as a responsibility. Isn't a supervisor a leader by virtue of position or authority? The answer depends on how you define leadership. In the sense we mean, not all supervisors are successful leaders.

Because leadership has a significant effect on the results achieved, you should consider it a supervisory responsibility. Furthermore, the way you handle other responsibilities contributes to how well you handle this one.

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